MAY, 1933.

GENERAL PHYSICS.

ADSORPTION.

1664. Expansion and Contraction of Coal Caused Respectively by the Sorption and Discharge of Gas. H. Briggs and R. P. Sinha. *Roy. Soc. Edinburgh, Proc.* 53. 1. *pp.* 48–53, 1932–1933.—Results obtained using 8 samples of coal and the gases firedamp and carbon dioxide at pressures up to 300 lb./sq. in. at about 18·6° C. show that coals expand slightly in all directions on adsorbing gas and that the process is approximately reversible. The expansion of Clarain is greater across than along the bedding. The changes of size were less with methane than with carbon dioxide. J. S. G. T.

1665. Measurement of Adsorption with Flowing Gases. H. Remy and W. Hene. *Kolloid Zeits.* 62. *pp.* 154–157, *Feb.*, 1933.—Determinations of the adsorption of sulphur dioxide and carbon dioxide on charcoal by a dynamic method (flowing gas) give values appreciably different from those found by a static method, and the ratio between the values for the two gases depends to some extent on the method used. The differences may be explained by differences in the state of the charcoal determined by the experimental conditions. The possibility of drawing conclusions concerning the adsorptive power of charcoal towards flowing gases from measurements made with gases at rest is shown ; the moisture-content, in particular, of the charcoal must be taken into account. This moisture-content influences the adsorption of different gases to different extents. T. H. P.

1666. Adsorption and Quantity of Adsorbent. Part I. A. Rabinerson. *Kolloid Zeits.* 62. *pp.* 157–162, *Feb.*, 1933.—The dependency of the amount of exchanged barium or calcium ions on the quantity of adsorbent (sodium- and hydrogen-kaolins, sodium permutit, Solonetz soil) is expressed by the equation, $x = \mathrm{K}.\, m^{1/n}$, x being the quantity adsorbed (exchanged ions), m the amount of adsorbent, and K and n constants. Over a wide range of mean values of m, the deviations of the calculated from the actual values of x are of the order of magnitude usual for adsorption formulæ. In the case of exchange-adsorption, the dependency of the specific adsorption on the amount of adsorbent is given by $x/m = \mathrm{K}.\, m^{-1/p}$, where $p = -1/n$; Kroecker's equation is applicable here as a first approximation. The " abnormal " rise in the $x/m - m$ curve is shown by the system Na-kaolin + $\mathrm{BaCl_2}$. An explanation for this anomaly is based on the diminution of the water-adsorption during Ba-exchange and the coagulation of small quantities of kaolin with excess of Ba. T. H. P.

1667. Application of the Gibbs Adsorption Theorem to Solid-Liquid Interfaces. F. E. Bartell, F. L. Miller and E. G. Almy. *Am. Chem. Soc., J.* 55. *pp.* 466–471, *Feb.*, 1933.—A method is developed for calculating adsorption at solid-liquid interfaces by means of the Gibbs adsorption theorem using adhesion tension instead of surface tension, or interfacial tension data. Adhesion tension values against silica and interfacial tension values against water are determined for three binary liquid systems throughout the entire concentration range. The order of " maximum " adsorption of a given solute (ethyl carbonate) from a series of three organic liquids (benzene, α-bromonaphthalene, and dimethylaniline) is the same whether silica or water is used as adsorbent, and is thus in agreement with previous observations concerning the similarity between a water and a silica surface in their relation to organic liquids. From the adsorption data and by means of the " modified " mixture law method, the area of adsorbed ethyl carbonate molecules is calculated, and the agreement found for three solvents and two adsorbents justifies the use of adhesion tension data for calculating adsorption at the solid-liquid interface. H. H. Ho.

1668. Adsorbed Caesium Films on Tungsten. I. Langmuir. *Phys. Rev.* 43. *pp.* 224–251, *Feb.* 15, 1933.—In a large heated enclosure having tungsten walls and containing Cs vapour in thermal equilibrium, there are ions, electrons and atoms, with concentrations given by $n_e n_p/n_a = K$; where the equilibrium constant K can be calculated from the ionising potential of Cs vapour. The interior of the enclosure constitutes a typical plasma with $n_e = n_p$. Near the walls are space-charge sheaths in which particles of only one sign are usually present. The potential distribution of the weak fields that reach into the plasma are governed by the Debye-Hückel theory characterised by the Debye distance λD. The sheaths contain an excess (or deficiency) of ions, and there is a corresponding sheath adsorption which is related to a negative surface tension (spreading force F) by Gibbs' adsorption equation. Still closer to the surface there is an image force sheath in which the distribution of ions and electrons is governed mainly by the image force $f = (e/2x)^2$. A general method is devised for calculating the image force (a second approximation) acting on electrons very close to the surface. An approximate calculation of the electron distribution is made and then the perturbations produced by a given electron are used to determine the image force on that electron. E. E. F. d'A.

ATOMIC AND MOLECULAR STRUCTURE.

1669. From the Physics of the Atom to the Physics of the Molecule. O. M. Corbino. *Elettrotecnica,* 20. *pp.* 118–121, *Feb.* 25, 1933.—The author sketches briefly the theory of the atom (Bohr, Sommerfeld, Schrödinger), the Heitler-London theory of the hydrogen molecule and the theory of ortho- and para-hydrogen. W. S. S.

1670. Electronic Structures of Polyatomic Molecules and Valence: Part IV. Electronic States, Quantum Theory of the Double Bond. R. S. Mulliken. *Phys. Rev.* 43. *pp.* 279–302, *Feb.* 15, 1933.—The possible types of electronic states of polyatomic molecules (assuming fixed nuclei and neglecting spin fine structure) are discussed and tabulated with the help of simple group theory methods, applying results of Bethe and Wigner. A notation for electronic states and molecular orbitals for molecules having any type of symmetry to be found among the 32 crystal classes, is adopted which is essentially the same as that used by Placzek for designating the vibrational states of molecules. It is shown how all the selection rules for transitions between electronic states of molecules can be easily determined. Limitations resulting here from the application of the Franck-Condon principle are discussed. Extending work of Bethe, tables are given showing how the various types of electronic states of atoms and of diatomic and polyatomic molecules go over into various other types of states if the symmetry of the original system is decreased. Examples are given showing how electronic wave functions of molecules can be constructed which conform to the possible types allowed by the symmetry of the nuclear skeleton and which, at the same time, with Slater's method, are antisymmetrical in the electrons. The approximate construction of molecular orbitals as linear combinations of atomic orbitals in such a way that they conform to the types allowed by the symmetry of the molecule is discussed and illustrated. Previous statements [see Abstract **4819** (1932)] on the quantum theory of the double bond are found to be justified by present results, and additional details concerning the nature of the double bond are given together with certain modifications of the previous model (*loc. cit.*). H. H. Ho.

1671. Atomic Radius of Carbon in Diamond. V. Posejpal. *Comptes Rendus,* **196.** *pp.* 337–339, *Jan.* 30, 1933.—Using formulæ derived in an earlier paper [see Abstract 5055 (1932)] and based upon an assumption that photons will only penetrate atoms to the depth of the energy level which is equal to their own energy, the author shows that from a measurement of the absorption of X-rays by diamond and of the refractivity for visual light it is possible to calculate the atomic radius of carbon. Good agreement with the values of Bragg and Debye has been found.

J. E. R. C.

1672. Third Report of Committee on Atomic Weights of International Union of Chemistry. G. P. Baxter, (Mme.) M. Curie, O. Hönigschmid, P. le Beau, and R. J. Meyer. *Am. Chem. Soc., J.* **55.** *pp.* 441–452, *Feb.,* 1933. *Chem. Soc., J. pp.* 354–361, *April,* 1933.—Two changes are recommended: I from 126·932 to 126·92, and La from 138·90 to 138·92. Results discussed but not held to justify change are: density of CO (1·25010) determined by Moles and Salezar, strengthening the evidence that C is slightly > 12·00; of N_2O (1·9804) by Batuecas, confirming the value for N; of Kr and Xe (Allen and Moore) implying 83·6 and 131·4 respectively; of Moles and others supporting 19·00 for F as against the results of Patterson, Whytlaw-Gray and Cawood; Hönigschmid's synthesis of Ag_2Se giving Se = 78·962, supported by Aston, and of $TeBr_4$ resulting in Te = 127·587; the result of Briscoe, Kikuchi and Peel for Tl is held untrustworthy. Decision between 1·00022 and 1·00012 as the conversion factor from the physical to the chemical scale is left unsettled, though recent determinations of the ratio $O^{17} : O^{18} : O^{16}$ favour 1·00022. Recent isotopic results regarding B, Cs, H^2, Li, K, Na, Te, and Zn are discussed. C. A. S.

1673. Mass Defect of Helium. E. Wigner. *Phys. Rev.* **43.** *pp.* 252–257, *Feb.* 15, 1933.—If one assumes that the potential energy between protons and neutrons has the shape of a simple potential hole, it is possible from the experimental value of the mass defect of H^2, to derive a connection between the mean width and the depth of this curve. This connection proves to be, to a large extent, independent of the finer details of the potential curve. By assuming a certain probable value, obtained from scattering experiments, for the width of the potential hole, it is possible to make calculations on the mass defects of other nuclei. Such computations were carried out for He and yield values which are greater than the mass defect of H^2 by a rather large factor. This agrees with experiment. For the higher elements, the Pauli principle has to be taken into account and the structure of higher nuclei is discussed on this basis. AUTHOR.

See also Abstracts 1682, 1700, 1828, 1830, 1842, 1897, 1943, 1946, 1966.

COLLOIDS.

1674. Preparation of Colloids by Ultrasonic Dispersion. N. Marinesco. *Comptes Rendus*, 196. *pp.* 346–348, *Jan.* 30, 1933.—Solids of low melting point, such as Wood's metal and phosphorus, are disintegrated in liquid dispersion media by ultrasonic vibrations. A. S. C. L.

1675. Colloidal Sulphur. O. v. Deines. *Kolloid Zeits*, 62. *pp.* 145–151, *Feb.*, 1933.—The first product of reactions such as those between sodium thiosulphate and acid and between hydrogen sulphide and sulphurous acid, which are commonly employed for the production of so-called colloidal sulphur, is actually a complex colloidal system of sulphur persulphide-sulphur stabilised by acid, a true colloidal sulphur solution not being formed until the persulphide has decomposed into hydrogen sulphide and sulphur. Many of the properties of sulphur sols described in the literature are in fact those of hydrogen persulphide solutions. The only true sulphur sols are those prepared by such methods as pouring an alcoholic sulphur solution into water. H. F. G.

1676. Electroosmosis and Electrophoresis. Part II. N. Schönfeldt. *Zeits. f. Elektrochem.* 39. *pp.* 103–116, *Feb.*, 1933.—A historical account is given of investigations on these subjects under the headings: introduction, technique, theories of the electric charge, experimental results concerning the properties of the double layer, and influence of the wall-charge on ionic migration. A copious Bibliography is appended. [See also Abstract 15 (1933).] T. H. P.

1677. Cataphoresis. An Improved Cylindrical Cell. A. Mattson. *J. Phys. Chem.* 37. *pp.* 223–227, *Feb.*, 1933.—The author has previously [see Abstract 628 (1929)] described a cylindrical cataphoresis (electrophoresis) cell for the ultramicroscopic determination of the speed of electrical migration and of the isoelectric point of colloidal materials, and a modified form has now been designed whereby the cell can be effectively cleaned. The mathematical derivation of the formula expressing the electroosmotic flow of the liquid is also included. H. H. Ho.

1678. Electrochemical Experiments with Gum Arabic Sol. W. Pauli and Emmy Ripper. *Kolloid Zeits.* 62. *pp.* 162–175, *Feb.*, 1933.—With highly purified gum arabic and tragacanth sols, the electrochemical properties have been studied by conductivity and potentiometric measurements, and the electrochemical behaviour on addition of neutral salts and strong acids, and the activity relations of the silver compounds potentiometrically and by means of the Donnan equilibrium dialysis. A marked discrepancy is found between the potentiometric activity determination of H^+ and the conductivity of the pure azidoid sol, the conductivity calculated from a_H being much higher than the value found. The normal results of the determinations of activity and conductivity on addition of neutral salts to these sols show that there is no general hindering of the conductivity or disturbance of the activity determination, but a change in the relation of the divergence coefficients $f a > f \mu$, such as occurs with chloridoid Al-oxide sols and with the osmotic coefficients for certain protein sols (Hammarsten effect). The activity relations of the sol-compounds with silver on addition of silver nitrate, acetate and hydroxide are compared with those for silver proteinates. T. H. P.

1679. Influence of Brownian Movement on the Viscosity of Suspensions. R. Eisenschitz. *Zeits. f. phys. Chem.* 163. *Abt. A.* 2. *pp.* 133–141, *Jan.*, 1933.—A theory of the viscosity of suspensions of ellipsoidal particles, based on a hypothesis analogous to the gas-kinetic theory, is developed and an expression is developed for this viscosity which takes account of the Brownian movement of the particles. T. H. P.

1680. Change of the Solvation Medium in Gelatin Sols. A. Sarluy. *Kolloid Zeits.* 62. *pp.* 176–180, *Feb.*, 1933.—Measurements have been made of the relative viscosities of gelatin solutions in phenol-water mixtures of different compositions at 70° C. The viscosity of a solution of gelatin in anhydrous phenol is very high, owing to the formation of a phenolic solvate coating on the micelle; the addition of water results in considerable diminution in the viscosity. T. H. P.

See also Abstracts 1703, 1745, 1772.

CRYSTAL STRUCTURE AND PROPERTIES.

1681. Topologically Equivalent Crystal Bonds. H. Heesch. *Zeits. f. Krist.* 84. *pp.* 399–407, *Feb.*, 1933.—A topological discussion of the diophantine equation $\frac{1}{i}+\frac{1}{j}+\frac{1}{n}+\frac{1}{m}=1$, for planes. *n/m* are the number of edges of an *n/m*-sided figure (triangle, quadrilateral and so on), and *i*, *j* the number of concurrent edges meeting at a point. There are four classes of solutions—A, B, C, D, as follows :—

A	$i \not\equiv j$,	$n \not\equiv m$
B	$i \equiv j$,	$n \not\equiv m$
C	$i \not\equiv j$,	$n \equiv m$
D	$i \equiv j$,	$n \equiv m$

where $\equiv$ means "topologically equivalent," and $\not\equiv$ means "topologically non-equivalent." A yields 13 particular solutions, B yields 6, C yields 6 (the polar of B), D yields 3. 9 cases (6 B, 3 D) refer to atomic lattices, 19 cases (13 A, 6 C) to compounds A_rB_m. Tables of co-ordination numbers, etc., are given. [See also Abstract 2950 (1931).] F. I. G. R.

1682. X-Ray Structural Measurements and Explanation by Tetrahedral Atomic Domains. R. Reinicke. *Zeits. f. Krist.* 84. *pp.* 468–474, *Feb.*, 1933.—A purely formal discussion of the author's work on tetrahedral working-regions, with particular reference to the periodic law and valency. F. I. G. R.

1683. Precision Measurements of Crystal Parameters. E. A. Owen and E. L. Yates. *Phil. Mag.* 15. *pp.* 472–488, *Feb.*, 1933. *Supplement.*—Using the technique described by Owen and Iball [see Abstract 3563 (1932)] the authors have accurately determined the lattice parameters of the following cubic elements : Au, Pt, Pd, Rh, Pb, Ir, Fe, Al, Cu and Ag. Before examination the metals (with the exception of Au and Pb) were annealed in vacuo. The accuracy obtained is of the order of 1 part in 20,000. The deviations from Bragg's law are allowed for. The crystal densities of the metals at 0° C. and 20° C. are calculated from the observed values of the lattice parameters. J. T.

1684. Lattice Structure of Indium. E. Zintl and S. Neumayr. *Zeits. f. Elektrochem*, 39. *pp*. 81–84, *Feb*., 1933.—Indium has a face-centred tetragonal structure with $a = 4 \cdot 583 \pm 0 \cdot 002$ Å, $c = 4 \cdot 936 \pm 0 \cdot 002$ Å and $c/a = 1 \cdot 077 \pm 0 \cdot 001$. The density is calculated to be 7·308 as compared with the pyknometric value of 7·314. F. J. W.

1685. Crystal Structure of β-Lanthanum. E. Zintl and S. Neumayr. *Zeits. f. Elektrochem*. 39. *pp*. 84–86, *Feb*., 1933.—The β-modification of lanthanum, which is stable at high temperatures, has a cubic face-centred lattice with $a = 5 \cdot 296 \pm 0 \cdot 002$ Å. If the density is taken as 6·17 the atomic radius is calculated to be 1·872 Å, which agrees with the value for α-lanthanum of 1·870 Å. F. J. W.

1686. Alloy Phases of the Type $NaPb_3$. E. Zintl and S. Neumayr. *Zeits. f. Elektrochem*. 39. *pp*. 86–97, *Feb*., 1933.—From powder and rotation photographs it is found that the structures of the following compounds are as follows: $CaPb_3$, cubic, $a = 4 \cdot 891$ Å; $SrPb_3$, tetragonal, $a = 4 \cdot 955$ Å, $c = 5 \cdot 025$ Å, $c/a = 1 \cdot 014$; $CePb_3$, cubic, $a = 4 \cdot 864$ Å; $CaTl_3$, cubic, $a = 4 \cdot 794$ Å; $CaSn_3$, cubic, $a = 4 \cdot 732$ Å; $CeSn_3$, cubic, $a = 4 \cdot 711$ Å. They are analogous structurally to $NaPb_3$: Ca, Sr or Ce in 000; Pb, Sn or Tl in $\frac{1}{2} \frac{1}{2} 0$, $\frac{1}{2} 0 \frac{1}{2}$ and $0 \frac{1}{2} \frac{1}{2}$. In all cases the atomic distances are much less than is to be expected from the additivity law. This is particularly true for $SrPb_3$ and in this case a slightly tetragonal lattice results. F. J. W.

1687. X-Ray Investigations of, and Action of HNO_3 upon Au-Ag alloys. M. le Blanc and W. Erler. *Ann. d. Physik*, 16. 3. *pp*. 321–336, *Feb*., 1933.—The solubility of the Ag component of a series of Au-Ag alloys in HNO_3 was studied. Solution of Ag occurs even in the case of an alloy containing less than 48 mol. % Ag. The solubility increases gradually until the Ag content is 57 mol. % and then begins to increase more rapidly. When the Ag content is 62 mol. % the Ag dissolves almost completely. There is no suggestion of a $^{n}/_{8}$ mol. "law." X-ray investigations confirm that the Au-Ag alloys form a continuous series of mixed crystals. The curve connecting the lattice spacings with percentage composition is parabolic, the smallest lattice constant occurring when the Ag content is about 50 mol. %. W. E. P.

1688. Diaminozinc Bromide: Crystallographic Study. S. Kozik. *Acad. Polonaise Sci. et Lettres, Bull*. 8–9 A. *pp*. 318–323, *Oct.–Nov*., 1932. *In German*.—This compound, $Zn(NH_3)_2Br$, formed in a Leclanché cell charged with ammonium bromide, forms pseudo-regular crystals of the rhombic system, $a : b : c = 0 \cdot 9227 : 1 : 0 \cdot 9556$, and exhibits high refractive indices and strong birefringence. T. H. P.

1689. X-Ray Studies of Divalent and Trivalent Nickel Compounds. R. W. Cairns and E. Ott. *Am. Chem. Soc., J*. 55. *pp*. 527–544, *Feb*., 1933.—The lattice constant of pure NiO is redetermined and found to be $4 \cdot 1684 \pm 0 \cdot 001$ Å. The lattice constants of $Ni(OH)_2$ are found to be $a = 3 \cdot 114 \pm 0 \cdot 005$ Å and $c = 4 \cdot 167 \pm 0 \cdot 005$ Å. Several supposedly new modifications of NiO previously reported in the literature are found to have the ordinary NiO structure. The reported existence of hydrates of $Ni(OH)_2$ is also disproved but the existence of compounds having the compositions $Ni_2O_3.H_2O$ and $Ni_2O_3.2H_2O$ is established. The mode of decomposition of these "hydrates" is studied, and it is decided that they are not true hydrates, but that the water is bound as hydroxyl groups. Structural formulæ are assigned. Two compounds are isolated, the chemical analyses of which suggest that they are hydrates of the hypothetical oxides Ni_3O_4 and Ni_8O_7, but their behaviour on decomposition shows them to be of a type analogous to $Ni_2O_3.H_2O$ and $Ni_2O_3,2H_2O$. Structural formulæ are proposed. J. T.

1690. Crystal Structure of Potassium Bromoselenite. J. L. Hoard and B. N. Dickinson. *Zeits. f. Krist.* 84. *pp.* 436–441, *Feb.*, 1933. *In English.*—The structure of potassium bromoselenite is deduced from oscillation and Laue photographs. The structure is found to be the same as that of potassium chlorostannate. The length of the side of the unit cube is 10·363 ± 0·02 Å. The Br-Se separation is 2·54 Å. The atomic radius of Se is 1·40 Å. J. T.

1691. Description and Structure of Lithium Hydroxide. T. Ernst. *Zeits. f. phys. Chem.* 20. *Abt.B.* 1–2. *pp.* 65–88, *Feb.*, 1933.—LiOH is tetragonal, with $a = 3·549 \pm 0·004$ Å, $c = 4·334 \pm 0·008$ Å : $c/a = 1·221 \pm 0·004$. The birefringence and mol-refraction (both for the D line) are 0·0118 and 4·49 respectively. The compound is optically positive. Translation-group Γ_t : Space group D_{4h}^7. A layer lattice structure is found (Ewald and Hermann, Type B_{10}). F. I. G. R.

1692. Optical Isomerides and Rates of Crystallisation. Non-existence of Racemates in the Liquid State. G. Rumeau. *Comptes Rendus,* 196. *pp.* 410–412, *Feb.* 6, 1933.—The rate of crystallisation of highly-purified *d*-rotatory dimethyl tartrate (α and β) forms was determined at 28° in presence of known impurities. Quantities of 0·5, 1, and 2 % of the following were added : water, *l*-dimethyl tartrate, inactive dimethyl tartrate, dimethyl oxalate, trimethyl citrate, *d*-camphor, and α-methyl sulphonate. The influence of water indicates the difficulty of its removal in the preparation of pure crystals ; the latter are very hygroscopic, and the absorbed water causes a partial hydrolysis. Determination of the effect, on the rate of crystallisation, of introducing traces of two optical isomerides and the racemic form into another substance shows that all three exert an equal effect ; from this it is concluded that racemates do not exist in the liquid state. [See also Abstract 1104 (1932).] N. M. B.

1693. Difference between Mica and Clay as regards Possible Orientation of Crystals on them. L. Royer. *Comptes Rendus,* 196. *pp.* 552–554, *Feb.* 20, 1933.—The micas, clintonites and chlorites (Group I) and talc, kaolin and pyrophyllite (Group II) are all geometrically similarly constructed of thin parallel planes. They differ in the fact that in (I) these planes are alternately electrically positive and negative, but in (II) uniformly neutral. Numerous substances when crystallised on a mineral of Group I exhibit epitaxy, but in no case when on one of Group II. It is clear therefore that for epitaxy there must be not merely geometrical agreement, but also similarity of polarity of the particles that replace one another at the point of union. [See also Abstract 1454 (1931).] C. A. S.

1694. Phlorizin Crystals. P. Gaubert. *Comptes Rendus,* 196. *pp.* 554–556, *Feb.* 20, 1933.—Addition of a small quantity (0·1–0·5 %) of almost any dye, natural or artificial, to hydrated phlorizin, $C_{21}H_{24}O_{10}$, $2H_2O$, causes the formation of larger crystals, most probably rhombic with n_α 1·604, n_β 1·615, n_γ 1·628 (yellow light). The hydrated crystals, density 1·431, when heated in vaseline oil at about 105° give off water and without melting pass into the anhydrous substance, density 1·452 and m.p. about

150°. The hydrated crystals, if small, when heated rapidly may melt at 100–110°; but ordinarily heated in air they become isotropic at about 101° losing water, but remaining transparent; they become pasty at 107–109°, but have no definite melting point; at about 130° anhydrous crystals form in the liquid which have n 1·620 (yellow light). The hydrated crystals sometimes lose water at the ordinary temperature. C. A. S.

1695. Influence of X-Rays upon the Formation of Crystal Nuclei. D. Samulacas. *Comptes Rendus*, 196. *pp.* 418–420, *Feb.* 6, 1933.—Experiments designed to show the effect of stimulation by X-rays. The following results are given:

Substance.	No. of Nuclei per cm.^{2} With X-Rays.	Without X-Rays.
Sulphur solution in CS_2	75	10
Phosphorus solution in CS_2 ...	59	14
Betol	84	29
Santonine	65	18

Data for irradiation periods are appended. F. I. G. R.

1696. Resistance Limits in Mixed Crystals with a Statistical Atomic Distribution. Part I. R. Glocker. Part II. R. Glocker and U. Dehlinger. *Ann. d. Physik*, 14. 1. *pp.* 40–50, *July* 1, 1932, and 16. 1. *pp.* 100–110, *Jan.*, 1933.—A statistical treatment of the solubility of homogeneous mixed crystals in which the atoms are irregularly distributed, shows that they possess a sharp resistance limit, *i.e.*, the velocity of attack rises suddenly when the concentration of the soluble atomic species is greater than a certain limiting concentration. When the soluble species occurs in single atoms this concentration is 50 %; for diatomic groups, 29 %; and for triatomic, 21 %. These results agree with Tammann's experimental work. F. J. W.

1697. Evaluation of Fibre Diagrams. E. Sauter. *Zeits. f. Krist.* 84. *pp.* 453–460, *Feb.*, 1933.—A method for the construction and use of the reciprocal lattice: application to substances (organic compounds) of high molecular weight. The paper contains a complete rotation-projection chart for a typical monoclinic case. F. I. G. R.

1698. Rotation X-Ray Goniometer Diagram. E. Sauter. *Zeits. f. Krist.* 84. *pp.* 461–467, *Feb.*, 1933.—The method provides an interesting "single-crystal" diagram, since by means of it the elementary cells of a reciprocal plane lattice are given directly. F. I. G. R.

1699. Direct Determination of Indices and Location of Spots in a Laue Pattern of Calcite. G. F. H. Harker. *Phil. Mag.* 15. *pp.* 512–527, *Feb.*, 1933. *Supplement.*—Assuming the lattice type and constants of calcite to be known, and that the pattern in a Laue diagram is due to the calcium ions only, the indices of the spots are deduced from first principles, and their location is calculated and compared with experimental results. C. A. S.

1700. Cooperative Phenomena. F. Zwicky. *Phys. Rev.* 43. *pp.* 270–278, *Feb.* 15, 1933.—The study is proposed of a group of phenomena so far not systematically treated. The term cooperative phenomena is adopted because of the fact that these phenomena are caused by interactions of a great number of elementary particles such as electrons, atoms, etc. These interactions extend over distances which are enormously greater than the usual action radii of the elementary particles. A brief survey of some possible cooperative phenomena in static and in stationary systems is given, and their importance in physics, astrophysics and biology is pointed out. Incidentally a generalisation of thermodynamics from static systems to stationary systems is discussed. The view is advanced that the existence of crystals is due to certain cooperative phenomena which fact would in general necessitate the existence of a secondary structure of crystals. The various general contentions and conclusions of this paper are illustrated and applied in the case of ferromagnetism. AUTHOR.

See also Abstracts 1671, 1710, 1849, 1899, 1906, 1912, 1929, 1937, 2008, 2054, 2055, 2081.

DENSITY.

1701. Binary Liquid Systems and the Mixture Rule. W. MacFarlane and R. Wright. *Chem. Soc., J. pp.* 114–118, *Feb.*, 1933.—When no reaction takes place on mixing two liquids then the properties of the mixture can be calculated from those of its constituents by the empirical relation $K(Q_1 + Q_2) = K_1Q_1 + K_2Q_2$. The best method of expressing the quantities Q of the liquids mixed depends on the property in question, and density, specific heat, refractive index, surface tension, viscosity and dielectric constant are discussed in this connection. Values deduced by means of the mixture rule for the first four of these properties, the quantities mixed being reckoned in succession on the basis of (*a*) weight, (*b*) volume, (*c*) molecular proportions, are compared with the corresponding experimental values. Four pairs of organic liquids were employed. It is concluded that the refractive index and density of binary liquid mixtures should be calculated using composition by volume, and surface tension should be calculated using composition expressed in molecular proportions. For viscosity no method seems satisfactory. P. H. B.

See also Abstracts 1683, 1684, 1694, 1845, 2012.

DIFFUSION AND OSMOSIS.

1702. Diffusion of Electrolytes. R. J. Davies. *Phil. Mag.* 15. *pp.* 489–511, *Feb.*, 1933. *Supplement.*—Using a modified form of Clack's method [see Abstract 2381 (1924)] the coefficients of diffusion ($k \times 10^6$) of $MgSO_4$ and $CdSO_4$ have been determined at 15·5° and 16·8° for concentrations of 0–4·5*N* (5·45–7·22) and 0–7*N* (3·52–4·73) respectively. Both show minima, for concentrations of 1·4*N* (5·23) and 1·8*N* (3·16) respectively, *i.e.*, for substantially higher concentrations than for KCl (0·3*N*) or NaCl (0·4*N*), for which salts *k* is much greater. Comparison with conductances shows that electrolytes with greater conductance have higher diffusion coefficients. These facts point to the presence of complex ions and a larger proportion of unionised molecules in the solutions of the sulphates, and also support the ionic solvation theory [see Abstracts 3232 (1927) and 2123 (1931)]. C. A. S.

1703. Diffusion of Colloidal Electrolytes: Sodium Oleate. M. E. L. McBain. *Am. Chem. Soc., J.* 55. *pp.* 545–551, *Feb.*, 1933.—Rate of diffusion is proportional to osmotic pressure and not to activity. Total diffusion is the sum of that of molecules and uncharged micelles, ions of uni- or poly-valent electrolytes and charged micelles, and charged micelles together with their compensating ions. Colloidal electrolytes, such as potassium laurate and sodium oleate, have high diffusion coefficients. The rate of diffusion of sodium oleate from sol, gel and curd differs only slightly. A. S. C. L.

1704. Osmosis in Systems Consisting of Water and Tartaric Acid. Parts I, II and III. F. A. H. Schreinemakers and J. P. Werre. *K. Akad. Amsterdam, Proc.* 35. 1. *pp.* 42–50 ; 35. 2. *pp.* 162–170, *and* 35. 4. *pp.* 477–485, 1932.—The diffusion of solutions through membranes is represented as follows. All concentrations between pure water (W) and pure solute (X) are measured as abscissæ along WX, the ordinates being termed W-points and X-points. Every solution has a W-point and an X-point. The whole of the W-points form a curve between the ordinates W^1 at abscissa W and zero at abscissa X ; similarly for the X-points. If a membrane separates two solutions of different composition, the water always diffuses from the solution with the higher W-point to that with the lower, whilst the solute diffuses from the solution with the higher to that with the lower X-point. Theoretically four cases are possible for the curves of W- and X-points : (1) neither curve has a maximum ; (2) only the W-curve has a maximum ; (3) only the X-curve has a maximum ; (4) both curves have a maximum. Aqueous solutions of tartaric acid separated by a cellophane membrane correspond with case (1), and those separated by pig's bladder with case (2). Experimental data are given. T. H. P.

See also Abstract 2092.

ELASTICITY AND PLASTICITY.

1705. Deformation of Elastic Plasters. E. Almansi. *Accad. Lincei, Atti,* 16. *pp.* 473–477, *Nov.* 20, *and pp.* 597–603, *Dec.* 18, 1932.—Calculates the deformation of a cylindrical surface of plaster comprised between two flat basal surfaces, a problem already treated mathematically by Clebsch. E. E. F. d'A.

1706. Diametral Compression of a Solid Cylinder. C. Weber. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 11–16, *Feb.*, 1933.—A cylindrical roller is compressed parallel to a diameter between the plane surfaces of two prismatic solids. The contraction of this diameter and the width of the area of contact are calculated by a new, direct method. The contractions of the prisms are then obtained by an approximation. The total contraction of the whole system of prisms and cylinder is, for any one load, independent of the radius of the cylinder. The problem is treated throughout as two-dimensional. J. P. A.

1707. Stress Distribution in Wedges with Arbitrary Boundary Forces. J. H. A. Brahtz. *Physics,* 4. *pp.* 56–65, *Feb.*, 1933.—A generalisation of the method of v. Kármán, applicable to the wedge, for any force distribution over the straight boundaries is outlined. In the first application the stress function is found for a concentrated force acting at any point of the boundaries of the three-quarter plane. Certain stresses are plotted. The stress functions are given without mathematical details for the following boundary conditions in the three-quarter plane : (*a*) Uniform tension over a part of the boundary ; (*b*) linear distribution over a part of the boundary ; (*c*) superposition of (*a*) and (*b*), giving hydrostatic distribution, with a plot of certain stresses. The discussion contains the stress functions for uniform continuous tension on one or both boundaries and points out the very interesting paradox that stresses may be finite for certain continuous loadings, but become infinite if a portion of the load is removed. AUTHOR.

1708. Deviation of Natural Gas from Boyle's Law. T. W. Johnson and W. B. Berwald. *Bureau of Mines, Techn. Paper No.* 539. [29 *pp.*], 1933.—The long distance transmission of large volumes of natural gas and the attendant problems dealing with the flow of the gas through pipe lines, and production problems, especially the estimation of gas reserves, have become of increasing importance. The simple relationship between pressure and volume as expressed by Boyle's law is not strictly applicable to natural gas ; and the amount of deviation from the law depends upon the temperature, pressure and chemical composition of the natural gas. The method employed in determining the deviation from Boyle's law of the various samples of gas consists primarily of accurate measurement of the volume of gas at approximately atmospheric pressure which results from the expansion of a known volume of gas under high pressure. Curves are given to exhibit the deviation from Boyle's law in terms of the absolute pressure. T. B.

1709. Resistance to Disruption of Crystals of Rock-Salt. L. Piatti. *N. Cimento,* 10. *pp.* 43–44, *Jan.*, 1933.—The author replies to criticisms of his previous paper [see Abstract 4095 (1932)] by Dommerich and Smekal. The angle between the normal to the plane of disruption and the direction of traction was observed though not measured systematically and the author considers that his qualitative conclusions were not vitiated by the absence of systematic measurement of this angle. He was satisfied that there did not exist any definite relation between the values of this angle and the resistance to traction in the specimens tested. J. J. S.

1710. Recrystallisation and Hardening of Aluminium due to Plastic Torsion. A. E. van Arkel and M. G. van Bruggen. *Zeits. f. Physik,* 80. 11–12. *pp.* 804–812, *Feb.* 23, 1933.—Torsion of fine-grained aluminium rods is shown to be, in part, a reversible phenomenon, successive torsion in opposite directions being characterised by the development of a maximum crystal size, dependent upon the degree of untwisting effected in the rod. The direction of this maximum recrystallisation corresponds with the axis of torsion, along which, minimum hardening occurs. An elastic after-effect is exhibited by poly-crystalline aluminium rods and, in general, by single crystals subjected to torsion. J. S. G. T.

1711. Two-Dimensional Elastic Wave due to Double Source. S. Higuchi. *Tohoku Univ., Technol. Reports,* 10. 4. *pp.* 1–11, 1932. *In English.*—The displacements resulting in an elastic medium from two periodically vibrating sources separated by a finite distance, are investigated analytically. When the mean distance of a point from the sources is greater than 2·5 times the separation, the effects are practically identical with those from a single source. The velocity of the waves generated varies with the distance from the source, but becomes constant at a great distance. Change of frequency has only a minor effect on the values of the stresses and displacements, particularly at points near the source. Examples illustrative of seismic phenomena are worked out. J. P. A.

1712. Forced Oscillations in an Elastic Rod. S. Higuchi. *Tohoku Univ., Technol. Reports,* 10. 4. *pp.* 12–37, 1932. *In English.*—Amplitude-frequency curves obtained from experiments on the transverse forced vibrations of rectangular bars, depart from a symmetrical form owing to internal resistance. An approximate estimate of yield points and solid viscosities may be obtained from the data. J. P. A.

1713. Diffraction of Plane Waves. S. Soboleff. *Comptes Rendus,* **196.** *pp.* **104–105,** *Jan.* **9, 1933.**—The problem of the diffraction of plane waves is treated by means of a representation of the solution of the wave equation on a Riemannian surface of logarithmic type. G. C. McV.

1714. Bending of Semicircular Plates and Rings. A. M. Wahl. *Univ. Pittsburgh, Bull.* **29.** *pp.* **242–249,** *Jan.* 10, **1933.**—A discussion of the most convenient approximate methods of obtaining the displacements of a loaded plate cut from a semicircle by removing a concentric semicircular portion. As a rule a test upon a specially constructed model is most satisfactory. J. P. A.

1715. New Method of Determining Elastic Moduli. P. le Rolland and P. Sorin. *Comptes Rendus,* **196.** *pp.* **536–538,** *Feb.* **20, 1933.**—The sample, in the shape of a long rectangular prism, is fixed vertically upright at the lower end, and a horizontal plate is fixed to the upper end; on opposite sides of this plate are suspended by their knife edges two identical gravity pendulums; one is started and the period of beats (intervals between successive stops of one pendulum), τ, is observed. Young's modulus is then given by $E = 8\pi^2 M(L^3 - l^3)\tau/ae^3T^3$, where M is the mass of a pendulum, T its period, e the thickness of the sample in the direction of flexion, a its width, and L, l the distances of the plate from the bottom and top of the fastening of the sample. E thus determined for cast iron is 6000–16,000 kg./cm². A similar method using two pendulums of identical torsion is applicable to the determination of rigidity (Coulomb's modulus). C. A. S.

1716. Theory of the Oscillation Measurer. H. W. Koch and W. Zeller. *Zeits. f. Instrumentenk.* **53.** *pp.* **64–70,** *Feb.,* **1933.**—For the differential equation which holds for all oscillation measurers a solution is quoted with a disturbance consisting of an ordinary sine oscillation with a phase displacement whereby a value is obtained for the amplitude and phase of the real oscillation of the measuring apparatus during the inswinging process. For powerful indicating instruments the influence of the real oscillation is small. For moving indicating instruments this influence is small for the extensometer, but large for seismographs. From the second integration of the original differential equation one finds how far the true constrained motion can be derived from indications of seismographs. On the left hand side of the equation, the constrained motion can be calculated immediately from known constraining forces, but in practice this is not possible since both constraining force and motion are sought. The right hand side must thus be evaluated numerically. The correcting curve is measured from a new zero line, but its position in many cases cannot be established accurately. Unavoidable errors are often also limited by the procedure of the corrector for seismographs. Finally, the influence of the magnitude of the phase displacement of the assumed force of constraint on the amplitude and phase of the true oscillation of the oscillation measurer is investigated. R. S. R.

See also Abstracts 1736, 1818.

GRAVITATION.

1717. Gravitation Constant. J. Zahradníček. *Phys. Zeits.* **34.** *pp.* **126–133,** *Feb.* **1, 1933.**—Describes the measurement of the gravitation constant by a resonance method, *i.e.*, by means of the oscillations which a secondary torsion balance takes up in the periodically variable Newtonian field of a primary torsion balance. The torsion balances used are described, and some measurements and photographic data are given which are very satisfactory. A. D.

See also Abstracts 1800, 1804.

HYDRODYNAMICS AND AERODYNAMICS.

1718. Current Lines Around a Cylinder of Revolution, at High Reynolds Number. J. Valensi. *Comptes Rendus,* 196. *pp.* 244–245, *Jan.* 23, 1933.—A method is described for photographing the current lines extremely close to a cylinder, 7·5 cm. in diameter and 10 cm. high, placed in a stream of water between parallel walls, the rate of flow being about 2 m. per sec. The lines, of which a photograph is reproduced, leave the cylinder at about 120° from the point of zero velocity. H. F. G.

1719. Points of Detachment of Lines of Slip. A. Weinstein. *Comptes Rendus,* 196. *pp.* 324–326, *Jan.* 30, 1933.—A purely mathematical treatment of the position of the lines of slip at a circular obstacle placed in a moving two-dimensional fluid. H. F. G.

1720. Air Pressure on a Cone Moving at High Speeds. G. I. Taylor and J. W. Maccoll. *Roy. Soc., Proc.* 139. *pp.* 278–311, *Feb.* 1, 1933.—The cone is considered to be moving at a velocity higher than that of sound, so that there is in front of it a shock wave, moving with the same speed as the cone itself. In the first part of the paper, the case is investigated mathematically where the flow is irrotational, and the pressure, velocity and density of the air stream are each constant over the surfaces of cones coaxial with the moving solid cone. The complete solution is obtained in numerical form, for cones of semi-vertical angle 10°, 20° and 30°. In the second part of the paper, the results are compared with experiment, both in respect of pressure distribution as measured in a wind tunnel, and also (for the 30° cone) by comparison with photographs of bullets in flight. In the latter case, the theory should only be applicable if the speed is 1·46 or more times the velocity of sound, and it is in fact found in the photographs, that the nature of the wave alters at about this velocity. The exact solution found, is compared with an approximation given recently by v. Kármán and Moore. This should be valid for thin spindle-shaped bodies, and does in fact agree well in the case of the cone of 10° semi-vertical angle, but diverges increasingly from the truth as the angle is increased. J. H. A.

1721. Hydrodynamical Problem. M. Gleijeses. *Accad. Lincei, Atti,* 16. *pp.* 435–438, *Nov.* 6, 1932.—Discusses the movement of a circular cylinder in a perfect liquid with solidal profile ; but concludes that the analytical solution of the problem is still to seek. A. D.

1722. Translational and Rotational Currents Round a Rectilinear Obstacle. U. Cisotti. *Accad. Lincei, Atti,* 16. *pp.* 465–470, *Nov.* 20, *and pp.* 541–547, *Dec.* 4, 1932.—Considers a straight line moving in two-dimensional space through a medium, and the same line ending in a circular attachment. The stream lines are semi-parabolæ when the motion is at right angles to the length. Discusses the carrying power of various combinations in the light of the theorem of Kutta-Joukowski and the formulæ of Blasius. E. E. F. d'A.

1723. Influence of Temperature on Stability of Gyrating Fluids. C. Woronetz. *Comptes Rendus,* 196. *pp.* 99–101, *Jan.* 9, 1933.—The author applies to the generalised problem treated by Riabouchinsky [see Abstract 147 (1933)], the method by Boussinesq and Rayleigh, where constant density is maintained by a term proportional to dilatation. Equations are written for a non-viscous fluid between two co-axial circular cylinders rotating uniformly and at different temperatures. Conditions of stability are examined; an unstable condition appears to be realisable and the wave-length is determined as a function of the angular velocity of the boundaries. T. L. M.

1724. Oscillation of Fluid in a Moving Tank. G. E. Pavlenko. *Phil. Mag.* 15. *pp.* 360–374, *Feb.*, 1933. *Supplement.*—Motion of fluid in an open tank, of arbitary or rectangular form, and performing an arbitary periodic motion, is discussed mathematically. J. S. G. T.

1725. Similitude of Transient Régimes in Rotational Movements. L. Escande and P. Dupin. *Comptes Rendus,* 196. *pp.* 242–244, *Jan.* 23, 1933.—The apparatus used consists of an outer, rotating, cylinder of 15 cm. diameter, and an inner, fixed, cylinder of 1 cm. diameter. About 5 min. are required for rotation to be established throughout the mass of liquid (water at 15° C.) when the outer cylinder rotates at 4 r.p.m. A series of curves relating the velocity V at a distance r from the axis have been obtained with the apparatus filled with water and with sugar solution, and from these it is shown that the t–V curves for water, t being the time required for the establishment of velocity V at any given distance from the axis, coincide with the corresponding tk–V/k curves for the sugar solution, where k is the kinematic viscosity of the solution, which is about 3·5 times that of water. H. F. G.

1726. Vortices Produced by Obstacles of Revolution Around an Axis Parallel to the General Direction of Flow. P. Dupin and M. Teissié-Solier. *Comptes Rendus,* 195. *pp.* 1226–1228, *Dec.* 19, 1932.—The obstacle used is a right cylinder supported by a circular concentric plate at the downstream end; periodic phenomena analogous to those previously reported for spheres, discs and inclined plates occur at this end. Photographs of 12 phases of the cycle are reproduced; the orientation of the plane of symmetry may vary during the observation, but the period appears to be independent of the position. If the Reynolds number is plotted against Strouhal's parameter (D/VT) for plate diameters of 8, 12, 16, and 20 mm., a unique curve is obtained which shows the Reynolds law of similitude to be applicable. The periodic phenomena begin at a Reynolds number of about 292. H. F. G.

1727. Stability of Vortex Currents. G. Durand. *Comptes Rendus,* 196. *pp.* 382–385, *Feb.* 6, 1933.—Mathematical. H. F. G.

1728. Effect of Obstacles on Flow of an Air Jet. H. Bouasse. *Ann. de Physique,* 19. *pp.* 89–228, *Feb.*, 1933.—The author studies the effect of obstacles of various forms in changing the forms of air jets impinging on them. He gives examples of stable conditions which, although quite different, can each be produced by the momentary introduction of auxiliary obstacles in the air-stream. J. W. T. W.

1729. Air Jet at Supersonic Velocities. L. Santon. *Comptes Rendus,* 196. *pp.* 525–526, *Feb.* 20, 1933.—The author uses an air jet issuing from a constriction 40 mm. in diameter and capable of speeds up to 1·3 times the velocity of sound. He has studied the velocity distribution, using the method of static pressure measurement. He has also compared his results with those given by a hot-wire anemometer. J. W. T. W.

1730. Recording of Stream Lines. U. Mennicke. *Zeits. f. techn. Physik*, 14. 2. *p.* 90, 1933.—The plate is dipped in a hot solution of gelatin and dusted with iron powder. After drying, water is allowed to flow between this plate and another. After some five hours of flow, the stream lines are marked as rusty lines on the plate, which must then be washed with spirits and dried to prevent the rust spreading. The stream lines are useful in studying the action of centrifugal separators. E. E. F. d'A.

1731. Flow of Water through Tubes. D. Nukiyama. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 90. *pp.* 233–290, *Jan.*, 1933. *In English.*—The velocity distribution in water flowing in tubes of either circular or square cross-section, both with and without obstacles, is determined by observing the motion of aluminium particles distributed in the stream. J. S. G. T.

1732. Wind Tunnel Development of a Proposed External Form for Steam Locomotives. J. J. Green. *Canad. J. of Research*, 8. *pp.* 37–61, *Jan.*, 1933.—The existing shape and arrangement of steam locomotives are such that smoke from the stack tends to sweep back along the boiler top and descend in front of the cab windows, seriously impairing forward vision. The paper describes work done in the wind tunnel of the National Research Laboratories and discusses the steps whereby an improved external shape has been evolved for locomotives such that the smoke is lifted over the cab, thus making possible an unimpaired vision ahead. The new design is the result of the application of elementary aerodynamics to the problem and aims at providing smoother air flow about the locomotive. Further, a layer of clean air is introduced between the smoke and the body of the locomotive and is responsible for maintaining the smoke above the cab. By removing the violent eddying flow about the locomotive the air resistance of the engine and tender has been reduced to the extent of some 35 %. AUTHOR.

See also Abstract 1862.

KINETIC THEORY OF MATTER.

1733. Reflection of Hg Molecular Rays at Crystal Surfaces. B. Josephy. *Zeits. f. Physik*, 80. 11–12. *pp.* 755–762, *Feb.* 23, 1933.—The reflection of Hg molecular rays at the surface of crystals of LiF and NaCl is investigated, the intensity of the rays being measured with a hot wire manometer. The existence of diffuse reflection is confirmed, but it occurs to a lesser extent than that found by Ellett and his co-workers. The reason for the discrepancy is not evident, but it probably lies in the previous history of the crystal. F. C. C.

See also Abstracts 1679, 1734, 1749, 1771.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

1734. Geometrical and Physical Conditions of Polished Surfaces. G. Schmerwitz. *Phys. Zeits.* 34. *pp.* 145–158, *Feb.* 15, 1933.—The method of measurement of radii of curvature of knife-edges previously described [see Abstract 1807 (1932)] is applied to determine the minute irregularities in the polished surfaces of precision balls and cylinders made from steel and glass. The cross-sections of these balls and cylinders are never found to be truly circular, for owing to the method of manufacture, they tend to form curves of constant " diameter " or thickness. With steel and glass balls having constant diameter within about $0 \cdot 1\mu$, it is claimed that irregularities in the polished surfaces of a few Ångström units can be detected by the method. Local variations of the order of 0·003μ occur from time to time in polished surfaces and these are traced to be due to Brownian movements of the particles in the surfaces. H. B.

1735. Apparatus for Comparing the Length of Gauges. C. Moon. *Bureau of Standards, J. of Research,* 10. *pp.* 249–255, *Feb.,* 1933. —The apparatus was designed particularly for standardising spherical-ended gauges of fused quartz by comparison with nominally equal flat-ended steel gauges the lengths of which have been determined by optical or mechanical methods. The micrometer screw used in the comparator is driven by a small reversible electric motor, the settings being automatically made by means of an electrical contact indicator which disengages an electromagnetic clutch at a definite measuring pressure of 150 gm. To allow easy endwise motion, the gauges are suitably supported on steel balls. Measurement is made between slightly convex faces each having a radius of curvature of 10 m. The complete comparator is mounted in a thermostatically controlled enclosure and all adjustments of the gauges are externally controlled. Micrometer settings may be repeated to within 0·1μ on gauges 10 cm. in length. H. B.

See also Abstract 1879.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

1736. Complex Tensor Equations in the Two-Dimensional Theory of Structures. A. Busemann. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 42–47, *Jan.,* 1933.—This entirely mathematical paper deals with the small number of rules necessary for dealing with the tensors arising in physical problems, and shows how spatial and plane considerations are related in the theory of structures. §1 deals with affinors (unsymmetrical tensors); §2 with the derivation of affinors; §3 with the relation of a tensor to an affinor; §4 with the gradient affinor; §5 with the tensor equations of the structure theory, and §6 with the work done during deformation. H. H. Ho.

1737. Equipotential Family of Plane Curves. S. Higuchi. *Tohoku Univ., Technol. Reports,* 10. 4. *pp.* 38–50, 1932. *In English.*—An investigation of orthogonal families of curves related to the epicycloid, the cycloid, the equiangular spiral, the Archimedian spiral, the catenary and the ellipse. J. P. A.

1738. Graduation of Data by the Orthogonal Polynomials of Least Squares. A. C. Aitken. *Roy. Soc. Edinburgh, Proc.* 53. 1. *pp.* 54–78, 1932–1933.—The problem of fitting a polynomial to data by using the method of least squares is discussed; the method of orthogonal polynomials is developed and new methods of arithmetical fitting introduced. Equidistant, unweighted and uncorrelated data are alone discussed. J. S. G. T.

1739. Method for Interpolating Data, Based on Dühring's Rule. J. H. Perry and E. R. Smith. *Indust. & Engin. Chem.* 25. *pp.* 195–199, *Feb.,* 1933.—An account is given of Dühring's rule and similar rules for the derivation of unknown vapour pressure data from determined values of the required data at either one or two points and the known corresponding data for reference substances as similar as possible to the substance in question. Convenient ways of using the rules are described. It is shown that the same general procedure may be used to estimate data of many other kinds. The solution of monohydrated salts, the change of viscosity with changing temperature, the varying calibration of a gas analysis apparatus for gas of varying composition, latent heat of vaporisation, electrolytic conductance, heat capacities, Joule-Thomson effects, mutual solubility of gases, and other properties are dealt with. Tables are given comparing observed values with values derived as described. P. H. B.

1740. Concepts of Inverse Probability and Fiducial Probability Referring to Unknown Parameters. R. A. Fisher. *Roy. Soc., Proc.* 139. *pp.* 343–348, *Feb.* 1, 1933.—The argument of Jeffreys [see Abstract 83 (1933)] in favour of a particular frequency distribution *a priori* for the precision constant of a normally distributed variate rests on the fallacy that the probability of the last of three observations, lying between the previous two, should be 1/3, irrespective of the distance apart of the latter. The apparent simplicity of the results of the assumption rests on the fact that the inverse and fiducial probability statements relating to the unknown parameter are thereby made to coincide, though logically they are entirely distinct. This particular distribution *a priori* is, however, unacceptable, since it implies that all ranges of values of the parameter covering finite ratios, however great, are infinitely improbable. J. S. G. T.

1741. Nomographs for the Complex Roots of Quadratic and Reduced Cubic Equations. P. Luckey. *Zeits. f. angew. Math. u. Mechanik,* 13. *pp.* 36–42, *Feb.*, 1933.—The search for the complex roots of equations with real or complex coefficients is not a new fundamental task for nomography, as soon as the left sides of the equations brought to zero are separated into their real and purely imaginary parts. This paper deals with typical examples of quadratic and cubic equations. H. H. Ho.

1742. Kinematic Analysis of some Mathematical Instruments. W. Meyer zur Capellen. *Zeits. f. Instrumentenk.* 53. *pp.* 56–64, *Feb., and pp.* 108–113, *March,* 1933.—For the particular instruments described, consisting of planimeter, analyser and integrator, the same general procedure has to be followed. At a particular point, or a particular part of the driving arm, here the travelling style, a movement is introduced, and at another place movement results because of the mechanism connecting the two points. The geometrical movement, kinematic law of the mechanism, and the kind of mechanical coupling are dealt with mathematically in the paper, not actually to derive afresh known laws, although these are occasionally obtained incidentally. The elemental path of the individual parts of the mechanism arises with ordinary considerations and the velocity and path in unit time are also traced. Particulars are given of the theory of action of two types of planimeter, three types of analyser and several types of integrator. R. S. R.

See also Abstracts 1716, 1744, 1827, 1948.

MECHANICS, CLASSICAL.

1743. Transcendental Equation in Statics. F. Tricomi. *Accad. Lincei, Atti,* 16. *pp.* 560–566, *Dec.* 4, 1932.—Deals with an approximate solution of a transcendental equation obtained by G. Krall [see Abstract 3318 (1930)] for determination of critical loads of a beam. A. J. McC.

1744. Finite Rigid Displacements. U. Cisotti. *Accad. Lincei, Atti*, 16. *pp.* 381–386, *Nov.* 6, 1932.—Develops a vectorial expression for finite rigid displacements, and gives comparisons with other expressions. A. D.

1745. Collisions in the Problem of Three Bodies. M. Kiveliovitch. *Bull. Astronomique*, 7. 9. *pp.* 415–417, 1932.—It is demonstrated that three bodies attracting each other proportionally to any power of their distances apart can have at most one collision, if moving in space, and two, if moving in a plane. G. C. McV.

1746. Centrifuge without Axle but of Great Stability and High Angular Velocity. P. Girard and C. Chukri. *Comptes Rendus*, 196. *pp.* 327–329, *Jan.* 30, 1933.—Details are given of a modification of the apparatus of Henriot and Huguenard [see Abstract 522 (1928)] in which great stability has been achieved. The angle of the stator is 90° and that of the rotor 95°, and the rotor profile is slightly concave. Using compressed air at 5 kg./cm.^{2}, the speed of a rotor 20 mm. in diameter is 240,000 r.p.m., and 360,000 r.p.m. of one having a diameter of 13 mm., corresponding to a peripheral centrifugal force of $0 \cdot 6 - 1 \times 10^6$ times gravity. H. F. G.

See also Abstract 1716.

MECHANICS, QUANTUM.

1747. Theory of Electron Spin. S. Shimasaki. *Tokyo B.D., Sci. Reports, No.* 23. *pp.* 251–273, *Jan.* 31, 1933. *In English.*—Dirac's relativity theory of the electron is modified by defining the impulse not by a quadratic, but by a linear formula since the components of the impulse in the field are not commutative, and by treating the spin angular momentum as a vector, when the factor i is left out of consideration. On this basis a result is obtained in the non-relativistic treatment similar to that due to the perturbation theory, except for an additional term relating to the spin magnetic moment. An essentially similar result is obtained on extending the theory to relativistic treatment. The corresponding first order linear differential equations are applied to the hydrogen atom and lead to Dirac's formula for the fine structure. N. M. B.

1748. Wentzel Approximation Process in the Relativity-Dynamics of the Electron. K. Bechert. *Helv. Phys. Acta*, 6. 1. *pp.* 82–88, 1933. *In German.*—In Pauli's recent publication [see Abstract 4121 (1932)] on Dirac's "Wave equation of the electron and geometrical optics," he has used Dirac's matrices, and the present author now shows that it is easier and more comprehensible to employ Sauter's proposed general method of indeterminate operators so long as only the general relations of the Dirac equation are under discussion. H. H. Ho.

1749. Experimental Test of Quantisation in Direction. R. Frisch and E. Segrè. *Zeits. f. Physik*, 80. 9–10. *pp.* 610–616, *Feb.* 16, 1933.—Continues the work of Phipps and Stern [see Abstract 1860 (1932)] on splitting up beams of potassium atoms, passing the splits through rotating fields, and again splitting up. A. D.

1750. Quasi-Mechanic Solution of the Quantum-Mechanic Wave Equation. O. Klein. *Zeits. f. Physik*, 80. 11–12. *pp.* 792–803, *Feb.* 23, 1933.—Treating the uni-dimensional quantum mechanic wave-equation as a differential equation of the first order with matrix coefficients, a quasi-mechanical approximate solution of the equation is derived. The process is applied to afford a closer approximation to the solution of the uni-dimensional Schrödinger and Dirac wave equations. J. S. G. T.

1751. Group-Velocity for Waves Associated with Phenomena. B. Finzi. *Accad. Lincei, Atti,* 16. *pp.* 489–496, *Nov.* 20, 1932.—The definition of group-velocity is extended to apply to a general system of waves, and a formula is obtained for this generalised group-velocity. The result is applied to the waves associated with a particle moving in a field of force. A. J. McC.

1752. Application of Riemannian Geometry of Complex Space to Wave-Mechanical Problems. U. Kakinuma. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 622–634, *Dec.,* 1932. *In English.*—In a previous paper [see Abstract 1518 (1932)] the author proposed a theory of the electron which enabled him to obtain an equation analogous to the wave-equation in wave-mechanics. Using an improved method of derivation the author shows that the wave-function may be interpreted as the square root of the energy-density in the electron. To overcome certain difficulties that present themselves it is found necessary to introduce the Riemannian geometry of complex space. The generalised quaternion units are used in place of the Dirac numbers as distinguishing factors of the four-beins. A pair of wave-equations are derived quite naturally, each depending on the complex value of the energy-density and its conjugate, respectively. H. L. B.

1753. Corpuscular Mechanics. F. J. de Wisniewski. *J. de Physique et le Radium,* 4. *pp.* 90–104, *Feb.,* 1933.—Mathematical. The author presents a corpuscular mechanics corresponding to the undulatory mechanics. His scheme is in a generalised form which explains experimental facts, notably in relation to neutral helium and its analogues, not amenable to the classical corpuscular mechanics. A. D.

1754. Mechanical Theory of Wave Mechanics and Quantum Mechanics. A. Korn. *Phil. Mag.* 15. *pp.* 236–241, *Feb.,* 1933.—Electron matter is regarded as compressible and as satisfying the hydrodynamic equations together with a supplementary equation, a modification of the Mariotte–Gay Lussac law, $p = c\mu$, where μ is the density. For vibrations of high frequency the constant c can become dependent on the frequency. To the ordinary vibrations must be added vibrational velocities, and an equation analogous to that of Schrödinger is obtained. Velocities are found the frequencies of which correspond to the differences and sums of the original vibrations, this leading to a mechanical explanation of the de Broglie waves, the spectral vibrations, the Raman and Compton effects, and of the modification of the Mariotte–Gay Lussac law, which, in turn, explains photoelectric phenomena and Richardson's law of flow of electrons from hot electrodes. N. M. B.

1755. Foundations of the Electron Wave Equation. S. R. Milner. *Roy. Soc., Proc.* 139. *pp.* 349–368, *Feb.* 1, 1933.—As opposed to the deduction of the wave field ψ, by means of which mechanical properties of matter are to be described, by successive extensions of classical mechanics and the introduction of relativity considerations at a late stage, the problem is treated initially as a four-dimensional one, and the differential equation of an arbitrary wave field is derived from first principles. By applying it to the electron wave field it is found that

Dirac's equation for ψ can be resolved into two equations, determining respectively the amplitude and the phase of electron waves in a given electromagnetic field. Consideration of the meaning of complex co-ordinates shows that the geometry of a manifold can be enlarged by their use so that the quantum periodic properties of ψ, and the sixteen generalised rotations discovered by Eddington can be accounted for geometrically in a manifold of four dimensions only. N. M. B.

1756. Higher Ionisation Potentials of Atoms According to the Thomas-Fermi Model. A. Sommerfeld. *Zeits. f. Physik,* 80. 7–8. *pp.* 415–422, *Feb.* 6, 1933.—The formula for ionisation potentials developed in a previous paper [see Abstract 95 (1933)] is corrected, and fairly satisfactory agreement is found between experimental and theoretical results for the sequence of values for the alkali elements. J. S. G. T.

1757. Some Inquiries Concerning Quantum Mechanics. W. Pauli. *Zeits. f. Physik,* 80. 9–10. *pp.* 573–586, *Feb.* 16, 1933.—The author discusses (1) the rôle of the imaginary unit and the notion of spatial probability distribution in wave mechanics, (2) the analogy between photons and electrons and their limits, and (3) the possible formulation of quantum mechanics in terms of a theory of close action (*Nahewirkung*), questions which have been already discussed by Ehrenfest [see Abstract 96 (1933)]. J. S. G. T.

See also Abstracts 1787, 1957, 1966, 2044, 2045, 2047, 2060, 2063.

RELATIVITY AND ETHER.

1758. Properties of Null Geodesics, and their Application to the Theory of Radiation. W. O. Kermack, W. H. M'Crea and E. T. Whittaker. *Roy. Soc. Edinburgh. Proc.* 53. 1. *pp.* 31–47, 1932–1933.—As a development of work by Whittaker [see Abstract 347 (1932)] the authors obtain a more general expression for the Doppler effect, developing and utilising the properties of null geodesics in a general Riemannian space for this purpose. A new formula for defining spatial distance, of more general form than that previously derived, is deduced. The concept of energy in general relativity is discussed in connection with the law of transfer of energy, and it is shown that the simplest and most natural assumptions regarding such transfer are precisely those necessary to ensure the general consistency of the theory of relativity with the principles of quantum theory. The results are applied to radiation in a statical universe, and to the reddening of light in an expanding universe. J. S. G. T.

1759. Relativity Cosmogony. R. Zaycoff. *Zeits. f. Astrophysik,* 6. 1–2. *pp.* 128–137, *Jan.* 18, 1933.—The author raises the question of the type of geometry which holds for physical space, arising from O. Heckmann's demonstration that a non-static universe with uniform distribution of matter does not determine the sign of the space-curvature. The gravitational equations for the three geometries are considered with and without a cosmic constant. The relation of mean density and radial motion with the so-called age of the universe is considered; various conclusions as to the expansion of space are derived, in particular the impossibility of periodic solutions of the gravitational equations. The connection between the world-radius and the radiation pressure and also the kinetic pressure effect of random motions in space is considered. The treatment is naturally mathematical. T. L. M

See also Abstracts 1747, 1784.

V. 19

SOLUTION.

1760. Solubility of Inorganic Compounds in Liquid Ammonia. M. Linhard and M. Stephan. *Zeits. f. phys. Chem.* 163. *Abt.A.* 3–4. *pp.* 185–195, *Feb.*, 1933.—A method and apparatus for the determination of solubilities in liquefied gases are described, and data are given for the solubilities of the nitrates, chlorides, bromides and iodides of sodium and potassium in liquid ammonia at 0° C. The solubilities increase from K to Na and from Cl to I. KCl is very sparingly soluble (0·132 %), but KI is more soluble in ammonia (64·8 %) than in water at the same temperature. H. F. G.

See also Abstracts 1687, 1702, 1739, 1968.

SURFACE TENSION AND COHESION.

1761. Adhesive Forces on Solidification. A. Sellerio. *Phys. Zeits.* 34. *pp.* 180–181, *Feb.* 15, 1933.—When water freezes on various surfaces, the force required to detach the ice from the surface is considerable, being as great in some cases as 12·6 kg. per sq. cm. Three forms of experiment are described, and temperatures from –7 to –12° C are taken. Sulphur on aluminium is found to reach a maximum of 55 kg. per sq. cm. at about 20° C. and to decrease almost parabolically to zero as it approaches its melting point. H. M. B.

1762. Behaviour of Organic Liquids between Parallel Plates. K. Schultze. *Kolloid Zeits.* 60. *pp.* 132–134, *Aug.* 1932.—It is found that similar deviations to those found in the case of water between narrow parallel plates of varying sizes [see Abstract 1813 (1932)] are also obtained in the case of organic liquids, the deviations being greater for the liquids of high vapour pressure. A. H.

1763. Surface Tension and Its Measurement. A. Ferguson. *Journ. Sci. Instruments.* 10. *pp.* 34–37, *Feb.*, 1933.—This lecture deals in a general manner with the relations between surface tension and other physical properties. From the relation between density of liquid and vapour phases and temperature up to the critical point which follows from the consideration of surface tension it is possible to subsume a number of relations originally put forward on an empirical basis. The total molecular surface energy Λ is dealt with in particular, and it is shown that it has a slight but definite maximum at about 0·8 m, where m is the reduced temperature. For chlorobenzene Λ is a maximum when $m=0{\cdot}76$. The lecture concludes with references to the formation and the detachment of drops and methods of measuring surface tension. P. H. B.

1764. Instability of Thick Films of Insoluble Oils on Water. C. G. P. Feachem and E. K. Rideal. *Faraday Soc., Trans.* 29. *pp.* 409–415, *Feb.*, 1933.—Potential-energy considerations are applied to determine the size of the smallest drops into which a thick film of oleic acid on water will break, the excess of the spreading-pressure of small drops over that of big ones, and the relative lives of small drops of different sizes in the presence of big drops. Counting and measurement of the drops show that each drop contains the excess oil in that area of film which it may be said to occupy; that small drops increase in size, and pass the oil in them into large drops; that the smallest drops observed are some ten times as large as the smallest permitted, but that the latter, if ever formed, would have a life of only about one-third of a second. T. H. P.

1765. Significance of Capillary Width for the Flow Potential. H. B. Bull. *Kolloid Zeits.* 60. *pp.* 130–132, *Aug.*, 1932.—It is known that between the two ends of a capillary tube whose walls are charged a p.d., the flow potential, exists, if a liquid is driven through the tube. It is also known that the liquid flows through electric osmosis if a p.d. exists between the two ends of such a capillary tube. If the flow is restricted the liquid will exert a pressure $P_1 = 8\,H\mu/r^2$, where H = the p.d. between the ends of the capillary, r = the radius of the capillary, and μ = the so-called dipole moment of the electric double layer. The value of this counter-pressure is calculated, and the results for different values of r are given. Previous investigations indicate that such an influence is first noticeable with a radius of less that 1 μ. With organic liquids it may occur with a greater radius. J. J. S.

1766. Shape of the Electrocapillary Curve of Mercury in Capillary-Inactive Electrotypes. R. M. Joshi. *Indian Journ. Phys.* 7. *pp.* 427–430, *Dec.* 1, 1932.—According to Koenig [see Abstract 3655 (1931)], when alkali metal salts are used as foreign electrolytes, amalgam formation most probably plays no part in the electrocapillary curve. It is found, however, that the electrocapillary curve for mercury in *N*-sodium nitrate, determined with a Lippman capillary electrometer with the mercury below and the electrolyte above, is not an exact parabola, the right-hand side being displaced inwards and extending slightly below the axis of applied potential. Moreover, formation of amalgam was apparent. It is evident that the original Lippman-Helmholtz theory does not furnish a complete explanation of the behaviour of capillary-inactive electrolytes like potassium and sodium nitrates, the effect of the electrolysis which begins as soon as the contact potential is overcome being left out of consideration.

T. H. P.

See also Abstracts 1667, 1701, 1739, 1949.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

1767. Time-Keeping—Old and New. F. Hope-Jones. *Journ. Sci. Instruments,* 10. *pp.* 43–49, *Feb.*, 1933.—After giving a brief summary of the advances in horology made between the fourteenth and seventeenth centuries, the author calls attention to the period of some 200 years which elapsed before any further notable improvement in the accuracy of time measurement occurred. During the last 40 years development has been much more rapid, and the author gives a general survey of the development of the Shortt free pendulum clock and mentions that the Shortt free pendulum clock has made possible the detection and measurement of nutation (by Jackson at Greenwich) and of the effect of lunar variation in gravity (by Loomis and others in America). Reference is also made to more recent work in accurate measurement of time which is being carried out by Tomlinson at the National Physical Laboratory and by Schuler at Göttingen. J. S. C.

VACUA, HIGH.

1768. Suction Velocity of Diffusion Pumps Driven by Organic Substances. H. Klumb and H. O. Glimm. *Phys. Zeits.* 34. *pp.* 64–65, *Jan.* 15, 1933.—The experiments now described show that it is possible by means of certain organic substances (*e.g.*, *n*-di-butyl phthalate, vacuum pump oil, and two paraffins of m.p. 42° and 68° C.) to improve the suction-service and attainment of high vacua by relatively simple experimental conditions. An efficient combination of a mercury-vapour pump with the new installation is recommended. H. H. Ho.

1769. Mercury-Driven Water-Stream Pumps for High Vacua. G. Mönch and H. Sturm. *Phys. Zeits.* 34. *pp.* 134–136, *Feb.* 1, 1933.—An investigation into the best conditions for the use of these pumps with the simplest means. A. D.

VISCOSITY, FRICTION AND LUBRICATION.

1770. Viscosity of Water. M. Golaz. *Comptes Rendus,* 195. pp. 1371–1373, *Dec.* 27, 1932.——The theoretical significance of results previously reported is discussed. H. F. G.

1771. Vapour Viscosities and the Sutherland Equation. J. H. Arnold. *J. Chem. Phys.* 1. *pp.* 170–176, *Feb.*, 1933.—Reversing the usual procedure of calculating molecular diameters from the kinetic-theory viscosity equation, it is suggested that the Sutherland constant be found, to serve as a criterion for the accuracy of this constant as obtained from viscosity-temperature data. The molecular diameter is taken proportional to the cube root of the molar volume of the liquid at the boiling point, as indicated by the theory of corresponding states; the error is small. Review of the available values of C indicates that many of them are erroneous, because of experimental error, magnified by extrapolation, or possible failure of the Sutherland equation. The Vogel rule, $C = 1{\cdot}47T_b$, is found valid to within 10%. The recent data of Braune and Linke, Melaven and Mack, and Lowry and Nasini are criticised. AUTHOR.

1772. Viscosity of Mixtures of Partially Miscible Liquids. Olive Oil–Water. R. Kremann, F. Griengl and H. Schreiner. *Kolloid Zeits.* 62. *pp.* 61–66, *Jan.*, 1933.—Rapidly stirred mixtures of olive oil and water exhibit a maximum viscosity at 24 % oil. The maximum is not displaced if the mixture is $0{\cdot}1N$ with respect to hydrochloric acid, or $0{\cdot}01N$ with respect to sodium hydroxide, but if further alkali is added the maximum shifts, occurring at 75 % oil in $0{\cdot}1N$ sodium hydroxide. The maximum viscosity falls with increasing hydrochloric acid concentration, and rises with increasing sodium hydroxide concentration to a maximum in $0{\cdot}01N$ solution; it thereafter falls rapidly. The results are discussed in relation to the nature of the dispersion, the particle size, and the interfacial charge. H. F. G.

1773. Viscosity of Aqueous Solutions as a Function of the Concentration. G. Jones and S. K. Talley. *Am. Chem. Soc., J.* 55. *pp.* 624–642, *Feb.*, 1933.—A method for the automatic measurement of the time of flow of the liquid in a viscometer of the Ostwald type by means of a photoelectric cell is developed. The viscometers are made of quartz and the method is capable of greater precision than the older methods. The viscosities of dilute aqueous solutions of six salts and two non-electrolytes were measured at 25° C. The results confirmed the prediction made by Jones and Dole based on the Debye theory of interionic attraction. F. J. B.

See also Abstracts 1679, 1680, 1701, 2012.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

1774. Theoretical Frequency Distribution of Photographic Meteors. P. M. Millman. *Nat. Acad. Sci., Proc.* 19. *pp.* 34–39, *Jan.*, 1933.—The author attempts to derive the probability of photographing meteors in different positions in the sky. Considerable simplifications are introduced : altitude of luminous meteors, assumed 100 km. ; constant linear velocity of all meteors with respect to earth ; constant luminosity ; constant density over cross-section, in the case of meteors from the same radiant. A definite absolute magnitude distribution of meteors entering the atmosphere at the same angle is assumed ; the form of this law is found to affect the results greatly. The various effects of distance from radiant and from zenith and of curvature of the earth are considered. The results are in the form of curves showing the relative probability of photographing meteors from radiants of certain altitudes ; and of photographing sporadic meteors, on the assumption of evenly distributed radiants, which is only true on the average throughout the night. T. L. M.

1775. Meteor Orbits Connected with Comet Pons-Winnecke. F. W. Smith. *Roy. Astron. Soc., M.N.* 93. *pp.* 156–158, *Dec.*, 1932.—An observed radiant, 1916, A.M.S.948, is discussed on the assumption of parabolic orbit, and of elliptic orbit with major-axis as for the comet ; the resulting ephemeris for shift of radiant, and a theoretical ephemeris from the comet elements, are compared with radiants observed on other dates. It is concluded that dispersive forces have separated the meteors from the comet orbit. T. L. M.

1776. Newton-Denning Method of Computing Meteor Paths with Celestial Globe. W. J. Fisher. *Nat. Acad. Sci., Proc.* 19. *pp.* 209–212, *Feb.*, 1933.—The author has combined the methods of Newton and Denning for the special case of two observers only, in connection with the reduction of certain fireball observations. He uses a globe with wooden horizon, brass meridian and a brass strap altitude arc ; errors in the final readings may be as great as a degree, but this is good enough for fireball data. The projections of the meteor path on the sphere, and those of the observers' positions lie on a great circle, and this plane gives a plane triangle whose angles are measured by arcs of the great circle. He describes the practical methods of solution, a slide rule being sufficient for most measurements. A. S. D. M.

1777. Study of Meteor Light Curves. D. Hoffleit. *Nat. Acad. Sci., Proc.* 19. *pp.* 212–221, *Feb.*, 1933.—Fifty of the least complicated trails of the AI series (made with three different lenses), all being short and wholly on the plate, were estimated in density at regular intervals by means of a photographic wedge. The resulting curves fall into two principal types. The first is characterised by a fairly smooth curve with a broad maximum. The second consists of the hair-line spindle trails (which are faintly visible for a large fraction of their entire paths, then brighten suddenly and vanish almost as rapidly), and in this type the relative lengths of the spindles are correlated with the positions of maximum brightness, a relatively long spindle corresponding to an early maximum, the average length being 8°·0 with a spread from 1°·0 to 19°·1 (but only three curves are longer than ten degrees). Of the 50 trails, 21 seem to have come from well-determined radiants, and except for two Leonid spindles all appear to belong to type I. There appears to be a scattering in the correlation between the fraction of the photographed path at which the maximum brightness occurs and the velocity at which the meteor strikes the earth's atmosphere; namely, the greater the velocity, the nearer to the vanishing point does the meteor become brightest. A. S. D. M.

COSMOGONY.

1778. Present Conception of the Structure of the Universe. E. Freundlich. *Naturwiss.* 21. *pp.* 86–93, *Feb.* 10, 1933.—Which star systems may be regarded, in the light of modern knowledge, as the independent structural components of the cosmos? The belief that the local cluster, of which the solar system is a minute constituent part, represents such an independent component can no longer be retained. It is now recognised that the local cluster is itself a constituent part of the larger galactic system which also includes the globular clusters, the diffuse nebulæ and the dark absorbing clouds. The great importance of the absorbing clouds is now more fully recognised than formerly; neglect of their influence has probably given rise to large systematic errors in previous statistical investigations and revealed simple symmetrical groupings which actually may not exist. A definite classification of the local cluster within the galactic system cannot be made until the nature of the structure of the galactic system as a whole is more completely revealed. The galactic system and the spiral nebulæ must at present be classified as the ultimate components of the universe but, on account of its size, it seems more reasonable to suppose that the galactic system represents a cluster of nebulæ. The question as to why the majority of nebulæ are of spiral structure remains unsolved. The discovery of the Hubble effect of spiral nebulæ is a stumbling block for all theories of the structure of the universe, since it reveals the whole universe as being still in an evolutionary stage of which no momentary unitary picture may be formed. J. E. K.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

See Abstracts 1700, 1776.

LATITUDE AND LONGITUDE.

See Abstract 1800.

NEBULÆ.

1779. Expansion Hypothesis for Planetary Nebulæ. H. Zanstra. *Roy. Astron. Soc., M.N.* 93. *pp.* 131–149, *Dec.*, 1932.—The broadening or doubling of the emission lines of planetary nebulæ suggests that these nebulæ are expanding, since the deduced radial velocity is greater than the velocity of escape. The hypothesis is investigated that these nebulæ are produced by a cataclysmic ejection of a gaseous envelope from the central star. The best agreement with observation occurs if it is assumed that, in this ejected envelope, a range of velocities, rather than a single velocity, occurs. The author points out that the quantitative agreement of the theory with observation is not very good, but the rarity of planetaries of large radius, and also of those with high velocities of expansion, is accounted for in a general way. G. C. McV.

1780. Monochromatic Luminosity of Gaseous Nebulæ. V. Ambarzumian. *Zeits. f. Astrophysik*, 6. 1–2. *pp*. 107–113, *Jan*. 18, 1933.—Photographs with wide slit, Simeis 39-in. reflector, were used to obtain the intensity of monochromatic images of nebulæ ; a comparison spectrum of a Go star was used to reduce the intensity to that of the sun ; the intensity used being that of one square second of arc, thus independent of distance, the author is enabled to compute the number of active atoms per unit of surface of the nebula ; two planetary nebulæ, for which the relative results in different wavelengths can be compared with previous work, and the Orion nebula are used. The order of the results is confirmed by theoretical considerations based on Zanstra's theory of gaseous nebulæ. T. L. M.

1781. Spiral Arms as Envelopes. B. M. Peek. *Roy. Astron. Soc., M.N.* 93. *pp*. 152–156, *Dec*., 1932.—In a rotating nebula the velocity of the rim from which matter is ejected is found to be of the order of magnitude of the radial velocity of contraction. In consequence the paths of the points of ejection are the envelopes of the orbits of the ejected particles. The various types of spiral paths, for different functions giving the rate of contraction, are studied and compared with the observed spiral arms of nebulæ. G. C. McV.

1782. Distribution of Remote Galaxies. H. Shapley. *Harvard Coll. Obs., Bull. No*. 890. *pp*. 1–3, *Dec*. 1, 1932.—The remarkable irregularity in apparent distribution of faint nebulæ (external galaxies), especially those brighter than magnitude 18·2, has been noted in previous papers. [See Abstract 920 (1933).] In low galactic latitudes this is often due to obscuration by clouds of dark matter, but that this cannot apply to high latitudes is shown by an examination which has been made of the distribution of stars to the 18th magnitude. The number of stars has been counted in regions rich and poor in galaxies, and there is no sign of correlation. Therefore, if obscuring matter is involved, it must be external to our own galactic system, but it is much more reasonable to assume that the irregularities are real and indicate actual groupings of external galaxies. Some rich concentrations appear to take the form of clusters. M. A. E.

1783. Brightness of Extra-Galactic Nebulæ and Galactic Absorption of Light. J. Dufay. *Comptes Rendus*, 196. *pp*. 101–104, *Jan*. 9, 1933.—If a galactic absorbing layer exists, the brightness of spiral nebulæ will vary with the cosecant of the galactic latitude ; a small term of the sort is found, but of the same order as the probable error ; if real, it indicates, by the difference between the hemispheres that the sun is 100 parsecs N. of the galactic plane, and that the amount of absorption is similar to that found for the local system by Malmquist. This does not affect absorption by clouds in limited galactic regions. The author finds a correlation between observed surface brightness and diameter of spirals, hence presumably with distance ; but inclines to attribute to methods of observation (central region predominating in larger objects) rather than to actual extra-galactic absorption. T. L. M.

1784. Observational Evidence for the Expansion of the Universe. H. Knox-Shaw. *Roy. Inst., Advance Proof* [29 *pp*.]. *Received Feb*., 1933.—An account is given of the observational methods of determining the distances of the spiral nebulæ, (1) by the period-luminosity relation for Cepheids detected in the nebula ; (2) by the detection of bright stars ; (3) by the apparent magnitude of a nebula, by which means the distance of a group of nebulæ in close proximity can be found. The methods of finding the velocities of recession of the nebulæ are also described. The highest velocity yet found is that of a faint cluster of nebulæ in Gemini which amounts to 24,000 km./sec. G. C. McV.

See also Abstract 1778.

PLANETS.

1785. Increase of Planet's Mass by Cosmic Dust. F. Zagar. *Accad. Lincei, Atti*, 16. *pp*. 627–632, *Dec*. 18, 1932.—The researches of Levi-Civita [see Abstracts 3347 (1930) and 395 (1931)] leave it uncertain whether the cosmic dust affects the rotation as well as the translation of the planets. The author shows that it does not as long as the particles have a Maxwellian distribution and a velocity small compared with that of the planet. E. E. F. d'A.

1786. Colour-Filter Photometry of Lunar Eclipse, 1931, April 2. N. Barabascheff and B. Semejkin. *Zeits. f. Astrophysik*, 6. 1–2. *pp*. 114–120, *Jan*. 18, 1933.—The authors photographed the eclipsed moon with red and blue filters ; in order to obtain absolute results they employed the uneclipsed moon ; for this a diaphragm was necessary ; and for comparison a series of diaphragms was required. The umbra is found to be $10^{m}\cdot80$ fainter than the uneclipsed moon for red radiation, $12^{m}\cdot74$ for blue. The ratio of red to blue radiation was not greatly variable within the umbra, but altered much more rapidly in the penumbra ; the results are tabulated in star magnitudes corresponding to distance from centre of shadow. T. L. M.

STARS.

1787. Simple Derivation of the Dissociation Formula. D. H. Menzel. *Nat. Acad. Sci., Proc*. 19. *pp*. 40–44, *Jan*., 1933.—The formula for the ionisation of a gas in thermodynamic equilibrium is derived directly from elementary considerations of the energies in a volume containing one ionised atom in its lowest state ; the derivation brings out the significance of the partition function, and in particular the ground for terminating the non-convergent series of this function at a point where the higher atomic states, due to broadening, form a continuum. T. L. M.

1788. Galactic Dimensions. H. Shapley. *Nat. Acad. Sci., Proc*. 19. *pp*. 29–34, *Jan*., 1933.—The survey of faint variable stars in 14 fields in high galactic latitudes reveals numbers of cluster variables apparently not members of globular clusters ; these are now shown by their magnitude distribution to be members of the galactic system ; the distances indicated by the faintest median magnitudes extend to 10,000 parsecs in high latitudes ; the distribution of the median magnitudes gives good evidence of an approach to the limit of the system ; these variables appear to occupy the same region as the globular clusters and so to outline the galaxy. The difficulties introduced by obscuring matter in lower latitudes are discussed ; galactic latitudes under ± 30° are generally not sufficiently clear of obscuration for the study of galactic dimensions. T. L. M.

1789. Absorption and Space Reddening in Galaxy as shown by Colours of Globular Clusters. J. Stebbins. *Nat. Acad. Sci., Proc.* **19.** *pp.* **222–228,** *Feb.,* **1933.**—Report based on observations made with a photoelectric cell attached to the Mt. Wilson 100-in. reflector; filters were interposed in front of the cell for colour measurements. With a cell of maximum sensitivity at 4500 Å, blue and yellow filters give effective maxima at about 4300 Å and 4800 Å, and between stellar spectra A0 and K0, the combination gives a colour-index difference of 0·44 mag. Satisfactory colour-indices have been made for clusters and nebulæ ranging from 12·5 to 13·0, so that all globulars have been observed north of – 30° since they are brighter than the 13th mag. A figure shows the tabulated results for 47 objects, and the reddening in low galactic latitudes is obvious. The author assumes a thin, homogeneous absorbing layer near the plane of the galaxy, and finds its thickness to be 540 ± 60 parsecs, or about twice the thickness found by Trumpler from open clusters, and three times that found by van de Kamp from a variety of evidence. When Shapley's centre is corrected for this absorption, it is found to be 10,000, not 16,000 parsecs from the sun. The author concludes that when allowance is made for absorption, the distances of some of the low-latitude clusters is but one-fourth of what was supposed, and that the diameter of our galaxy is reduced from 80,000 to perhaps 30,000 parsecs, so that the great difference in size of our galaxy from other systems largely disappears. A. S. D. M.

1790. Stars in Field Nine of the International Cepheid List. J. J. Nassau and S. K. Towson. *Harvard Coll. Obs., Bull. No.* **890.** *pp.* **9–12,** *Dec.* **1, 1932.**—As part of the international programme on Cepheid variables, 144 plates taken at Harvard and lent by Shapley have been examined by the authors. The magnitudes of four Cepheids appearing on the plates were estimated and their light-curves deduced. M. A. E.

1791. Long Period Variable RT Hydræ. D. J. K. O'Connell. *Harvard Coll. Obs., Bull. No.* **890.** *pp.* **13–18,** *Dec.* **1, 1932.**—This star was discussed by Ludendorff in 1923, using all observations then available. The present study is based on 1200 estimates made on Harvard plates at Cambridge, Arequipa, and Bloemfontein between 1899 and 1932. The secondary minima in the earlier part are shallow, but later they become deep, and a definite interchange appears to take place with the primary. The star seems to be a link between the RV Tauri and the R Centauri groups of variables. M. A. E.

1792. Eclipsing Binaries RW Aræ and SW Ophiuchi. Martha B. Shapley. *Am. Acad., Proc.* **67.** *pp.* **537–550,** *Dec.,* **1932.**—The two systems have in common the character of constant maximum light, with a barely measurable indication of a secondary eclipse; their light curves show no trace of ellipticity or reflection effects. For RW Aræ, 866 plates were used; for SW Ophiuchi, 631. Their formulæ for primary minimum are respectively J.D. 2419755·6911 + 4^d·3675094E ± 0·0000025E (p.e.) and J.D. 2420740·4691 + 2^d·4459310E ± 0·0000016E (p.e.). For RW Aræ two solutions are given; one for uniform distribution in brightness and one for total darkening at the limb; the semi-duration of totality for darkened stars is but a third that of the alternative assumption and gives a rounded minimum and a slightly better fit to the observations; it is therefore adopted. For SW Ophiuchi the two assumptions give identical results. In RW Aræ the components are well separated; the small bright star has about $1\frac{1}{2}$ times the sun's diameter and the larger, fainter star has about 5 times; the inclination is low, relatively, for a total eclipse. The low density combined with faint absolute magnitude of the large, dark companion presents a puzzling phenomenon not seen in isolated stars and conflicting with normal views of stellar spectra and luminosity. SW Ophiuchi has its fainter component nearly twice the diameter of the brighter and both much larger than the sun; it is a remarkably normal eclipsing binary for an A0 star in size, orbit, density, magnitude, surface brightness and parallax ($0''\cdot001$). A. S. D. M.

1793. Three Bright Novæ. L. Campbell. *Harvard Coll. Obs., Bull. No.* 890. *pp.* 3–9, *Dec.* 1, 1932.—Tables of observations and light-curves are given for the three stars Nova Aquilæ 1918, Nova Cygni 1920, and Nova Pictoris 1925, covering approximately eight years for each. Although similar in several respects, the three curves show some marked differences. M. A. E.

1794. Suggested Mechanism of Class Be Stars. D. B. McLaughlin. *Nat. Acad. Sci., Proc.* 19. *pp.* 44–49, *Jan.*, 1933.—The problem is to interpret the cyclic changes of relative intensity of the two components of emission lines of H divided centrally by absorption lines. A binary theory meets objections as to resultant mass, variations of period, etc. The author regards such stars as temperature variables with a range producing only small variations of visual magnitude. Variable selective radiation pressure produces the effect of an expanding and contracting atmosphere and the relation of absorption and emission is accounted for by simple Doppler effects, the atmosphere being in rapid rotation and the lower parts of the star rotating even more rapidly. The principal difficulty, the relative constancy of the central absorption and also of the total emission, is briefly considered. T. L. M.

1795. Spectroscopic Elements of Eclipsing Variable, GO Cygni = H.D. 196628. J. A. Pearce. *Roy. Astron. Soc. Canada, J.* 27. *pp.* 62–65, *Feb.*, 1933.—This 8th magnitude was discovered photographically in 1928 by Schneller, and observed by Kukarkin and Syczyrbak (who showed it to be a typical β Lyræ star with $\mathrm{Max}_1 = \mathrm{Max}_2 = 8^m\cdot40$; $\mathrm{Min}_1 = 8^m\cdot83$ and $\mathrm{Min}_2 = 8^m\cdot51$) and, lastly, from the spectroscopic side by the author, who finds both stellar and interstellar K-lines, the velocity of the latter being -13 km/sec. The final spectroscopic elements are $P = 0\cdot717767$ days; $e = 0\cdot0$; w, indeterminate; $T =$ J.D. $2426953\cdot0425 \pm 0\cdot0122$; $\nu = +3\cdot2 \pm 1\cdot04$ km/sec., $K_1 = 133\cdot2 \pm 1\cdot74$ km/sec.; $K_2 = 156 \pm 1\cdot96$ km/sec. The system is composed of two dwarf stars of spectral types B9 and A0; with masses similar to our sun's; revolving in sensibly circular orbits whose radii are not much greater than our sun's diameter; with a period of rotation the same as their axial rotations. The stars are ellipsoidal in figure with their largest axes coincident with the line joining their centres. Kukarkin's light curve indicates the presence of some small mutual reflection and ellipticity effects.
A. S. D. M.

1796. Proper Motions and Orbital Motions Obtained from the Astrographical Catalogue of Catania Observatory. A. Bemporad. *Accad. Lincei, Atti*, 16. *pp.* 470–473, *Nov.* 20, 1932.—The catalogue, published at intervals of about 30 years, lends itself particularly well to the determination of proper motions and orbital motions. The author selects three characteristic stars: (1) BD + 51°·1696. This star has a proper motion of 1″·076. (2) BD + 50°·2054, a physical binary. The proper motions of the two constituents 1904·85–1924·41 are − 0″·0224 and − 0″·0214. (3) BD + 53°·1797 a physical binary. Its position angle was 208°·9 in 1902·48, and 220°·8 in 1904·46. E. E. F. d'A.

See also Abstracts 1758, 1783, 1872.

SUN.

1797. Solar Flocculi Observed with Royal Observatory, Greenwich, Spectrohelioscope during 1932. F. W. Dyson. *Roy. Astron. Soc., M.N.* 93. *pp.* 168–173, *Jan.*, 1933.—Observations were made on 171 days. These are classified under: (*a*) 106 central areas of bright Hα flocculi; a table is given of the frequency of the measured values ranging from − 6 to + 4 km/sec., and these are compared with 157 bright flocculi outside the central part; a table gives an average displacement of about − 0·6 km/sec. (that is outward from the sun) which may have significance; (*b*) 49 central dark Hα flocculi not associated with sunspots or bright flocculi; these also give a mean displacement of − 0·6 km/sec.; (*c*) 166 dark flocculi near sunspots and evidently related to them, these are generally short-lived and limited in area, a maximum of the velocities occurs between 20 and 50 km/sec., and are mainly inwards; (*d*) dark Hα flocculi associated with bright areas of Hα flocculi, but not with any sunspot then present, these show few velocities between 20 and 40 km/sec.; (*e*) 10 eruptions of bright Hα flocculi, these are tabulated with the date of any magnetic disturbance recorded at Abinger within 4·0 days of the time of central meridian passage. There is also a table of measured light intensities of 125 bright Hα flocculi (including 9 bright eruptions) showing that the most frequent light ratio for flocculus to background is 1·4. A. S. D. M.

1798. Spectrum of Solar Corona, June 29, 1927. A. Jenvall. *Astron. Iaktt. och Undersökning. Stockholm Obs.* 11. 8. [25 *pp.*], 1932. *In French.*—The author's results, at a station near Järpen, include a comparison of coronal intensity with a Hefner lamp, with various screens (the value of the results is shown by their agreement with Wien's law), showing the eclipse to have been unusually bright; a table of wave-lengths from corona spectrogram; determination of isophots from direct photograph of corona; observations of contacts; and meteorological observations. A more detailed discussion of the continuous spectrum of the corona includes a treatment of the effect of halation, tables of relative intensity of continuous spectrum in 8 wave-lengths, and comparisons with formula: $m = m_0 + 7\cdot5 \log (h + 0\cdot151)$ where h is height from limb in solar radii (Balanovsky-Perepelkin), which is fully confirmed. T. L. M.

1799. Velocity of Rotation of Sun at Different Depths. E. J. Perepelkin. *Zeits. f. Astrophysik*, 6. 1–2. *pp.* 121–127, *Jan.* 18, 1933.—The author describes observational methods and results for 1932 at Pulkovo, in the determination of the sun's equatorial velocity of rotation by various chromospheric and Fraunhofer lines. Results are tabulated and compared with those of recent observers; the apparent increase of velocity suggested by Evershed [see Abstract 1557 (1932)] is not confirmed. T. L. M.

See also Abstracts 1723, 1778.

GEOPHYSICS.

GEODESY.

1800. Measurements of the First Order Geodetic Station at Mount Crea. U. Barbieri, *Accad. Lincei, Atti,* 16. *pp.* 500–504, *Nov.* 20, 1932.—The author gives an account of the measurements of latitude, azimuth, longitude and gravity at the first order trigonometrical station at Mount Crea, July 17–21, 1930. The results are stated. The method and apparatus were similar to those previously employed by the author in work along the Mondovi meridian. E. L. J.

1801. Influence of Vertical Diurnal Oscillations on the Results of High Precision Levelling. E. Prévot. *Comptes Rendus,* 196. *pp.* 605–607, *Feb.* 27, 1933.—The author suggests that certain systematic, notable and abnormal errors of precise levelling obtaining at different epochs in France and elsewhere may be traced to a deformation produced by weather conditions. The amplitude of certain periodic diurnal, vertical variations appears to have a thermal and seasonal origin, and is not due to astronomical causes. Observations at St. Maur Observatory showed, between 10 and 16 hours in July, 1928, an amplitude of 0·65 sec. in the W.-E., and 0·45 sec. in the N.-S. direction, and thus of 0·8 sec. in the SW-NE direction. Errors of levelling in this mean direction can thus amount to 4 mm., while other sources of error do not exceed 1·5 mm., on a fine summer day. Thus along a line Brest-Strasburg for observations at 7–11 and 14–18 hours the error may amount to 2·8 m. when other sources of error do not exceed 11 cm. The author considers that geodesists should examine not merely the variations of intensity of gravity, but also changes in its direction. R. S. R.

1802. Photographic Process for Preparing Topographical Maps. R. Ferber. *Comptes Rendus,* 196. *pp.* 389–391, *Feb.* 6, 1933.—A modification of the author's photoplanimeter is described enabling an accurate orthogonal projection on a horizontal plane of the area concerned to be obtained irrespective of the levels of that area, and of obliquity of the original photographs. By it the rate of working is increased from 100 to 450 cm.^{2}/hr. C. A. S.

See also Abstract 1824.

GEOPHYSICS, APPLIED.

1803. Geoelectric Methods in Oil Prospecting. O. H. Gish. *Am. Assoc. Petroleum Geologists, Bull.* 16. *pp.* 1337–1348, *Dec.,* 1932.—The high resistivity of oil may, under favourable circumstances, allow it to be located directly, but it is usual to survey the associated structures as in the gravimetric and seismic methods. The greatest promise in this field is shown by the resistivity and electromagnetic methods, but they are handicapped by the lack of a quantitative basis. Extensive precautions are necessary in measurements, illustrated by the resistivity method in which polarisation, contact potentials, earth potentials, induction effects, leakage, etc., have to be eliminated. A true value of the methods can only be obtained from a statistical study of the data available, but there is no doubt that they will be accepted as useful aids in the search for oil. J. M. B.

1804. Anomalies in Lines of Equal Gravity. A. Belluigi. *Gerlands Beitr. z. Geophys. Angew. Geophys.* 3. 4. *pp.* 230–235, 1933.—A summary is given of various methods used for the interpretation of the lines of equal gravity. A general method is given for the calculation of the depth of the causes of the anomalies in these lines, such as the occurrence of large perturbing masses. This method is simplified by the use of Belluigi's multiplication network. J. J. S.

1805. Theory of Refraction Shooting. M. Muskat. *Physics,* 4. *pp.* 14–28, *Jan.,* 1933.—The linear nature of the time-distance curves obtained in seismic prospecting implies that the impulses must travel along paths governed by the laws of geometrical optics. An analysis of the case of a point source of compressional waves, in one of two semi-infinite fluid media separated by a plane interface, shows that at any other point in the medium containing the disturbance three impulses are recorded, the direct pulse, the reflected pulse and a distorted pulse whose time of arrival corresponds to the refraction path. The radial and vertical displacements due to this pulse decrease with the square of the distance and they have magnitudes of the same order as the displacements due to the reflected pulse. In the general case of elastic media, in which transverse waves are possible, the disturbance arriving at the observation point may be analysed into four pulses following refraction paths as well as the direct and reflected waves. The times of arrival along the " refracted paths " correspond to pulses which travel partly as longitudinal and partly as transverse disturbances. J. M. B.

See also Abstracts 1801, 2005.

HYDROSPHERE, PHYSICS OF THE.

1806. Omission in the Classical Theory of Tides. O. Pettersson *Comptes Rendus,* 196. *pp.* 361–364, *Jan.* 30, 1933.—The author deals with a vertical force (F) produced by the sun and moon on water molecules below the water surface where gravity is balanced by the pressure in the fluid. He finds at the autumn equinox at 12 *h.* for 22–9–30 that F = $1 \cdot 922 \times 10^{-8}$gm. upwards at the equator and $-\ 0 \cdot 942 \times 10^{-7}$gm. downwards at the N. pole. There results a force from pole to equator. Considering the boundary surface between the upper layer of least density and the lower levels extreme mobility may cause a rhythmic variation of F. Depths are given for this boundary surface at several places. The author considers this may explain numerous series of observations in Scandinavian seas with a semi-diurnal period. **E. Fichot,** commenting on these results, states that the theory is not new. It is true only when the depth is small compared with the wavelength and may even be reversed for short period oscillations. Brillouin has given a theory to account for these facts. R. S. R.

1807. Influence of the Pacific on the Circulation in the South-West Atlantic Ocean. A. J. Clowes. *Nature,* 131. *pp.* 189–191, *Feb.* 11, 1933. Using 72 stations for densities mostly in the Scotia Sea stream lines were charted for a depth of 600 m. in relation to those at 3000 m. These show a considerable flow eastwards through the Drake Passage on both sides of the Antarctic Convergence, at the surface and at great depths and the flow continues northeast to an area northwards of S. Georgia. The flow at 2000 m. is in the same direction as at 600 m.

but slower. This conflicts with the views of Defant and Wust. The temperature-salinity curves confirm that the warm, more saline, intermediate layer in the S.W. Atlantic originates in the Pacific and only north of 46° S is it of Atlantic origin. From 46° to 55° S it is of Pacific origin. The transport of water from the Pacific to the Atlantic is $1 \cdot 1 \times 10^8$m.^{3}/sec. The circulation of the southern ocean shows two surface layers, the Antarctic and the Sub-Antarctic, separated by the Antarctic Convergence. South of the boundary are whirls affected by topography of the coast and sea bottom and north of it the sub-Tropical Convergence is found. R. S. R.

LAND, PHYSICS OF THE.

1808. Earth Fractures. M. Billings. *Am. J. Sci.* 25. *pp.* 140–166, *Feb.*, 1933.—The various types of fractures and faults are considered, and some of the mechanical problems arising out of them are stated. The paper is well illustrated by diagrams of earth faults. W. A. R.

METEOROLOGY.

1809. Cloud Formation in Consequence of Pressure Changes in a Temperature Field. O. Dengel. *Gerlands. Beitr. z. Geophys.* 38. 2. *pp.* 126–141, 1933.—The formation of clouds under certain conditions of temperature and pressure is studied practically and theoretical conclusions are drawn as to the dependence of the different types of clouds and their movements upon the motion of the air caused by the temperature and pressure gradients. Eight different cases are considered, photographs of clouds and diagrams showing various types of formation under different conditions are given. It is claimed that the results should increase considerably the accuracy of weather forecasts. H. M. B.

1810. Micro-Climatology. R. Geiger. *Naturwiss.* 21. *pp.* 132–137, *Feb.* 10, 1933.—Reference is made to the many influences of small changes of climate from one place to another on such botanical subjects as growth of pine trees, orchids and compass plants. Animals take account of these differences as is shown in the construction of burrows by rabbits in dunes, incubation of ants' eggs and of bark beetles' eggs. For mankind these facts are of importance in the siting of sanatoria, hospitals and dwelling houses. The effects of dust from towns on the formation of nocturnal temperature inversions and increased cloudiness and of streets and public squares on temperature changes are also discussed. R. S. R.

1811. General Spectrum of the Night Sky as Observed in India. K. R. Ramanathan. *Indian Journ. Phys.* 7. *pp.* 405–410, *Dec.* 1, 1932. —Reference is made to the results obtained by Sommer, Lord Rayleigh, Dufay and Slipher on bands in the night sky spectrum and their presence or otherwise in the auroral spectrum. The results obtained by the author at Poona should not be affected in this low latitude by the aurora. His results are similar to those of Slipher and thus the general spectrum of non-polar auroræ must be world wide. Lines corresponding to Lord Rayleigh's X_1 and X_2 are identified. In the zodiacal light the intensity falls off rapidly in the shorter wavelength side of 4400°Å. The Fraunhofer lines G and H are identified and the line 5577°Å is found strongly, while some other peaks of intensity corresponding to the night sky spectrum are visible. Five of Slipher's lines in the zodiacal spectrum are also found accurately to the limits of measurement. [See Abstract 3754 (1932).] R. S. R.

1812. Height of the Aurora and Temperature of the Upper Atmosphere. G. Angenheister. *Terr. Mag.* 37. *pp.* 431–438, *Dec.*, 1932. *In German.*—The author deals first with the following phenomena which have been used to determine the atmospheric temperature above 35 km., (1) explosive sound waves, (2) temperature of the ozone layer, (3) illumination and extinction of meteors, (4) helium content of the atmosphere, and (5) scattering of the green auroral line. The author employs a method involving the change of height of the absorption layer for auroral light at the transition from day to night, using Störmer's observations on auroral levels. He derives a temperature distribution with height for the bright and dark parts of the atmosphere. For a thoroughly mixed atmosphere this leads to a mass distribution in agreement with the observed height of the auroral rays in the bright and dark regions of the atmosphere, assuming that the mass in any given vertical column is unchanged. By day the layer at 100–200 km. is heated to 1000° Abs. and expands, while at night it cools to 300°Abs. in this layer and sinks. Little heating occurs in the layer 200–700 km., while at 700 km. the temperature does not change from 300°Abs. The heating and cooling occur in a few hours. In lower layers less heating results and the action is also delayed, the change at 40–50 km. being only a few tens of degrees.

R. S. R.

1813. Dependence of the Hair Hygrometer on Temperature. A. Pfeiffer. *Gerlands Beitr. z. Geophys.* 38. 2. *pp.* 196–201, 1933.—Measurements have been made of the state of a bundle of hair at different temperatures and relative humidities. Aqueous solutions of $CaCl_2$ and NaCl were employed to obtain constant relative humidity at the different temperatures. Assuming correct values at 20° C. the temperature coefficient was calculated for the ranges 0°–20° C. and 20°–35° C. and these values were compared with those of Kleinschmidt and Pircher. It is shown that, in opposition to the results of Kleinschmidt and Pircher, a shortening of the hairs occurs with rise of temperature. This is supposed to be due to loss of water from the hairs, and the consequent shortening overcomes the expansion of the hairs due to rise of temperature. The effect is more noticeable over the range 0°–20° C. For saturated hairs there is a regular change of length over the whole range 0°–35° C. Further, in the transition from the state of saturation for water to that for ice, water is lost and a shortening occurs due to the fall of temperature, which explains the larger Kleinschmidt coefficient. R. S. R.

1814. Theory of Wet and Dry Bulb Hygrometer. F. J. W. Whipple. *Phys. Soc., Proc.* 45. *pp.* 307–317 ; *Disc.*, 317–319, *March* 1, 1933.—The formula for the wet- and dry-bulb hygrometer is discussed on the lines of the theory given by G. I. Taylor, and it is suggested that in the formula $(e^1-e)=\beta P(\theta-\theta^1)$, the value of β is likely to be of the form $(1-e^1/P)(c/nL)$ rather than simply c/nL. For these equations, θ and θ^1 are the dry- and wet-bulb temperatures, e and e^1 the corresponding saturation pressures of water, P the barometric pressure, whilst c/nL depends on the thermal properties of water and the densities of air and water. The values of β calculated from the experimental results of Awbery and Griffiths [see Abstract 2493 (1932)] do not suffice to decide between these values, and tables based on each of the hypotheses are given. They differ only very slightly. J. H. A.

1815. Calibration of Moving-Vane Anemometers for Low Velocities. R. Loewenstein. *V.D.I.* 77. *pp.* 177–178, *Feb.* 18, 1933.—The ordinary methods used for calibrating anemometers lead to large errors when the velocities under consideration are below about 2 metres per sec. The author describes a method of calibration in which the anemometer is lifted at a constant controllable speed in a vertical shaft. The air temperature in the shaft is so regulated that there are no noticeable convection currents. The estimated accuracy is 1 % at a speed of 0·5 m. per sec. J. W. T. W.

See also Abstract 1826.

SEISMOLOGY.

1816. Studies in Reflected Seismic Waves. Part I. Computations of the Reflection of Seismic Waves at Solid Boundaries. L. B. Slichter and G. V. Gabriel. *Gerlands Beitr. z. Geophys.* 38. 2. *pp.* 228–238, 1933.—The author refers to six previously computed reflections. Only two of these can be considered to simulate to any degree the discontinuities now thought to occur in the upper crust. For one of these the results are only qualitatively applicable in crustal studies because no change in density is provided and the value taken for Poisson's ratio (0·16) is very small, while for the other the incidence of SV waves is not considered and transformed waves are disregarded entirely. In the present paper seismic reflections and refractions arising at discontinuities of the type supposed to occur in the upper crust are considered for three cases. Numerical values of the auxiliary coefficients are tabulated against the angle of incidence on the basis of an incident wave of unit coefficient. The values are considered to be accurate to 1 % of the largest coefficient. Graphs show the values of the coefficients plotted against the angles of incidence of the original wave. These show complicated relations with abrupt changes. Generally the coefficient increases greatly when the associated wave assumes nearly grazing angles of incidence. R. S. R.

1817. Studies in Reflected Seismic Waves. Part II. Surface Motions due to Reflections in a Layered Crust. L. B. Slichter. *Gerlands Beitr. z. Geophys.* 38. 2. *pp.* 239–256, 1933.—The author postulates a crust having defined values for thickness, density and velocity for the upper (granitic), intermediate and underlying media. The more prominent secondary waves arising from the original waves of types P, SV and SH are selected and discussed. Of the innumerable secondary waves arising in the layers, five derived from an original compressional wave and seven from the shear wave have considerably greater influence than others, and with one exception they originate from transformations either at the main discontinuity or at the free surface. All others are of higher order, and with several exceptions may be omitted except for their possible bearing upon resonance phenomena in crustal vibrations. The relative amplitudes of the surface motion, and their arrival times are calculated for the twelve prominent secondary waves and plotted as functions of epicentral distance. In many cases the contributions to the surface motion from secondary waves produced by internal reflections in the crust are noteworthy, and tend to produce a motion of an irregular oscillatory type. Finally, the influence of crustal discontinuities at the source on secondary motions due to internal crustal reflections are discussed. R. S. R.

1818. Elastic Systems Vibrating under Transient Impulse. M. Biot. *Nat. Acad. Sci., Proc.* 19. *pp.* 262–268, *Feb.*, 1933.—The effect of a transient impulse on an undamped elastic system is shown to result from the superposition of free vibrations, the amplitudes of which are related to corresponding terms in the expression for the statical deflection of the system, and to the " spectral intensities " for the various frequencies. The theory, which is developed both by the operational methods of Heaviside and by use of the Fourier integral, points to a way in which earthquake records may be more easily analysed. An extension to damped systems is discussed. J. P. A.

See also Abstracts 1711, 1716, 1805.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

1819. Sources of Errors in the Determination of the Potential Gradient of the Earth's Electric Field. A. G. McNish. *Terr. Mag.* 37. *pp.* 439–446, *Dec.*, 1932.—In potential-gradient data it is important to consider space-charge distributions. The magnitude of these effects is investigated for various space-charge conditions. Errors in reduction-factor determinations from this source are calculated and conditions for minimising them outlined. Equations are developed for the effect of finite space-charge distributions on the quantity V/h. If the horizontal extent of the space-charge layer is several times its thickness errors introduced by considering its horizontal extent as very great are negligible. J. J. S.

1820. Air Earth Current at Kew Observatory. F. J. Scrase. *Meteorolog. Office, Geophys. Mem. No.* 58. [22 *pp.*], 1933.—The memoir deals with the results of an investigation the objects of which were: (*a*) to devise a method of obtaining a continuous record of the current free from the effect of field changes; (*b*) to fix how far the current varied with other conditions. The apparatus used consists essentially of an insulated plate about 91 cm. square, connected to one pair of quadrants of an electrometer. The electrometer deflection affords a measure of the charge due to the current. A second electrometer connected to a collector enables the potential to be found. The author proceeds to explain how the value of the currents can be obtained from the records and what corrections must be applied to the direct readings. The results cover a period of twelve months, and the main part of the analysis deals with values obtained during quiet conditions. Tables show the mean hourly values of current, conductivity and potential gradient. The means are in satisfactory agreement with values hitherto found with the Wilson apparatus. Annual variations of potential gradient follow the usual form. The current curves differ slightly from those hitherto found. Diurnal variations of potential gradient and conductivity follow the normal behaviour at land stations, but the current shows a marked seasonal change in the type of variation. A special section deals with observations during fog. The sign of the charge entering the ground in fog is often reversed, while that of the potential gradient is not. Several plates illustrating this are appended. The author concludes that these large negative currents may be due to charges brought down by very small water droplets. A. E. M. G.

1821. Propagation of a Lightning Discharge through the Atmosphere. E. C. Halliday. *Phil. Mag.* 15. *pp.* 409–420, *Feb.*, 1933. *Supplement.*—The question of the method of propagation of a lightning discharge through the atmosphere has engaged the attention of several investigators and various methods of attack on the problem have been resorted to. In the present paper the author describes the results of observations on lightning flashes made by the method suggested by Boys [*Nature*, 118. *p*. 749, 1926]. After describing the rotating camera used, where speeds a little over 1500 r.p.m. could be attained, he proceeds to discuss the measurements made on three photographs of lightning. From these he concludes that a lightning flash (1) may be propagated from the ground towards the cloud, or (2) may start from the ground and join up with a flash starting from the cloud, or (3) may start from a point above the ground and be propagated both upwards and downwards. On one occasion, forking in a discharge was observed to occur both upwards and downwards, so that evidently the forking does not afford in every case a criterion of the direction of propagation of the discharge. Photographs of the camera used and of the flashes observed are appended, while line diagrams throughout the text serve to give a clearer view of the main features of these discharges. The images were measured with the micrometer microscope of the Yale University. A. E. M. G.

1822. Determination of the Constant Ratio between the Final and Initial Volumes in the Progressive Decomposition of Fulminating Matter at Atmospheric Pressure for the same Initial and Final Temperatures. E. Mathias. *Comptes Rendus*, 196. *pp*. 455–458, *Feb*. 13, 1933.—The author describes a phenomenon observed at Courtry on Sept. 6, 1880, in which a white luminous beam was observed at a height of 100 m. with a length three times its height. It appeared like two halves of a luminous ball which disappeared, without noise, after acquiring a red tint and with the halves separating. It occurred during conditions preceding a thunderstorm and was repeated twice. Assuming a quasi-adiabatic change during the expansion he is led to an increase of volume amounting to eight times the original value. R. S. R.

1823. Magnetic Map of Italy. L. Palazzo. *Acad. Lincei, Atti*, 16. *pp*. 374–381, *Nov*. 6, 1932, and 17. *pp*. 340–341, *March* 5, 1933.—A contribution of material from Piedmont for the reconstruction of the magnetic map of Italy. A. D.

1824. Magnetic Observations at Mogadiscio. M. Bossolasco. *Accad. Lincei, Atti*, 16. *pp*. 576–584, *Dec*. 4, 1932.—Description of the geodetic station at Mogadiscio and instruments there. Summary of magnetic observations made. A. D.

1825. Summary of the Year's Work, Department of Terrestrial Magnetism, Carnegie Institution of Washington. J. A. Fleming. *Terr. Mag*. 37. *pp*. 455–462, *Dec*., 1932.—Much statistical investigation of accumulated observational material has been carried out. It was concluded, from a discussion of magnetic correlations with solar conditions, that there must exist in the sun's surface certain restricted areas which cause terrestrial magnetic disturbances, but which are not detectable by the usual astrophysical means. Tests were made of the van de Graaff electrostatic generator as a source of high voltage, and in the development of the means of observing and measuring atomic and nuclear phenomena under high-energy rays. From a study of hyperfine structure as dependent on different isotopes of the same element it is concluded that isotope-shifts may be explained as due to changes in nuclear dimensions. The efforts of the Department to realise the International Polar Year programme are detailed. The gradual change in the direction of the magnetic axis and in the magnetic moment of the earth are accompanied by other fluctuations of temporary character or of shorter period. Examination of isopors, or lines of equal annual change lead to the conclusion that the isopors of declination forming an oval in eastern Brazil, the inclination isopors forming a similar pattern in Ecuador, and the H-isopors surrounding the West Indies are all contracting towards their respective centres. Other references are made to magnetic work in China, S. Africa and Spitzbergen, to atmospheric-electric studies, the effect of terrestrial-magnetic variations and the lunar period on radio transmission, the improvement of the ship's compass, and the study of earth currents at several observatories. G. E. A.

1826. Progress in the Photography of the Aurora Borealis. C. Störmer. *Terr. Mag.* **37.** *pp.* **475–477,** *Dec.,* **1932.**—German and Norwegian scientists collaborating in an investigation on the instantaneous photography of the Aurora Borealis, carried out in the winter of 1931–32 a series of experiments at Tromsø. The present note is a brief account of the chief results from the work. By using an Astro RK lens and by sensitising the plates, the investigators were able to obtain instantaneous photographs with exposures less than one-half second even on moderately bright displays. This reduction in time of exposure has opened the way to aurora borealis kinematography, and displays in the stage of formation and eclipse were recorded. Colour photographs of tranquil arcs were also obtained with specially sensitised plates. An interesting feature was disclosed in the auroral spectrum. After filtering the visible and ultra-violet rays it was verified that the spectrum possesses two bands in the infra-red with limits at 7883 and 8095 Å. These are considered as probably due to nitrogen. The note contains also several reproductions of auroral photographs taken under different conditions. A. E. M. G.

1827. Value of the Spherical Function and its Derivation for the Most Important Terrestrial Magnetic Observatories. G. Fanselau. *Terr. Mag.* **37.** *pp.* **463–473,** *Dec.,* **1932.** *In German.*—For many investigations, especially regarding the nature of terrestrial magnetism, spherical functions are used. To make the process easier a table of values of spherical functions is given for the most important terrestrial magnetic observatories. Values are obtained according to a method given by A. Schmidt. R. S. R.

See also Abstract 1812.

RADIOACTIVITY.

1828. Bond Energies and Mass Defects in Atomic Nuclei. W. M. Latimer and W. F. Libby. *J. Chem. Phys.* 1. *pp.* 133–136, *Feb.*, 1933.—The problem of the interpretation of the mass defect curve is discussed in reference to the coupling of protons and electrons proposed by Latimer [see Abstract 2576 (1931)]. Gamow's equation is modified by making the attractive energies the sum of the bond energies. For certain symmetrical nuclei approximate values for the mass defect may be calculated which are in good agreement with the experimental results. AUTHORS.

1829. Wave-Mechanical Theory of α-Particle Scattering. K. K. Mukherjee. *Phys. Zeits.* 34. *pp.* 175–179, *Feb.* 15, 1933.—Assuming a polarisation force varying as the inverse 5th power of the distance from the centre of the nucleus, the author calculates the scattering produced by various nuclei at different angles and obtains fair agreement with the results of other authors. J. E. R. C.

1830. Absorption of β-Rays by Organic Compounds and the Molecular Structure of the Latter. G. Fournier and M. Guillot. *Comptes Rendus,* 196. *pp.* 412–414, *Feb.* 6, 1933.—Previous work on inorganic compounds [see Abstract 2468 (1932)] is extended to an investigation of the absorption of β-rays by nineteen hydrocarbons of various types. A relation is found between the small variable difference Δ between the observed and calculated mass absorption coefficients and the structure of the hydrocarbons, as follows: lengthening of the main carbon chain, or of the lateral chain in aromatic compounds slightly increases Δ; the introduction of an ethylenic bond lowers Δ by a constant amount; the benzene ring acts as if possessing three ethylenic bonds; the introduction of an acetylenic bond lowers Δ to an extent twice that due to an ethylenic bond. The effect of carbon in saturated and unsaturated hydrocarbons is analogous to that of diamond and graphite, respectively, supporting Debye's suggestion based on X-ray crystal analysis that carbon is aliphatic in diamond and aromatic in graphite. N. M. B.

1831. Anomalous Absorption of γ-Rays. [Possibility of the Quantum Jump of the Rest-Mass of an Electron.] B. Arakatsu. *Faculty of Sci. and Agric., Taihoku Imp. Univ.* 5. *pp.* 163–168, *Dec.*, 1932. *In English.*—The paper is mainly mathematical. The author assumes that the phenomena of the anomalous absorption of hard γ-rays in heavy elements are due to the quantum jump of the energy of an oscillator electron or system of oscillator electrons surrounding the nucleus. The theoretical value deduced for the additional absorption coefficient per atom approaches satisfactorily to the experimental value. W. E. P.

1832. Internal Conversion of γ-Rays and Nuclear Level Systems of Thorium B and C. C. D. Ellis and N. F. Mott. *Roy. Soc., Proc.* 139. *pp.* 369–379, *Feb.* 1, 1933.—Previous results [see Abstracts 990, 991 (1933)] indicated that the internal conversion coefficients, α, for the γ-rays of RaB.C and RaC.C′, when plotted against hν, lie on two curves, one for dipole and the other for quadripole radiation. The evidence from ThB and ThC is now examined. ThC.C″ [see Abstract 2895 (1932)] definitely supports this view, ThC″.Pb, ThB.C, and ThC.C′ are not against it, but require further investigation. Level schemes for ThC.C″, ThB.C, and ThC″. Pb are discussed, and assuming that γ-radiation is due to single excited particles making transitions in which the orbital angular momentum changes by multiples of $h/2\pi$, quantum numbers l are suggested for the various levels. Quadripole transitions are more common than dipole. The much smaller number of α-particles from RaC.C′ as compared with that from ThC.C′ with its weak γ-radiation [see Abstracts 150 and 3322 (1932)] is explained by the potential barrier for ThC being slightly lower than that for RaC. C. A. S.

1833. Atom Disintegration at Low Potentials. H. R. v. Traubenberg, A. Eckardt and R. Gebauer. *Naturwiss.* 21. *p.* 26, *Jan.* 13, 1933.—The authors have made experiments to determine the lowest potentials required to produce protons which will disintegrate lithium. They used a canal-ray tube yielding from 1·6 to 7 × 10^5 protons per second, the lithium was placed as near as possible to the kathode and the scintillations were observed over a wide angular range. Distinct disintegration was obtained with tube voltages as low as 29 kV. Scintillations were observed when the proton velocity, determined by magnetic deflection, was 13 kV, the proton current being of the order of 1 mA. The number of scintillations increased rapidly with the voltage in accordance with the Gamow theory. [See following Abstract.] W. E. P.

1834. γ-Rays Produced during the Disintegration of Lithium. H. R. v. Traubenberg, A. Eckardt and R. Gebauer. *Zeits. f. Physik,* 80. 7–8. *pp.* 557–558, *Feb.* 6, 1933.—Using a canal-ray tube which has already been described [see preceding Abstract] the authors have searched for the γ-rays which, due to there being two groups of α-particles emitted during the disintegration, should be present. By a simple device, the errors due to X-rays generated in the canal tube are allowed for. A tube counter was used to detect the γ-rays. Definite evidence of γ-rays was obtained, and the number of quanta, as determined by the tube counter, was found to be of the same order as the number of α-particle scintillations observed at the same time. J. E. R. C.

1835. Disintegration of Lithium by High-Energy Protons. M. C. Henderson. *Phys. Rev.* 43. *pp.* 98–102, *Jan.* 15, 1933.—Using the Laurence h.t. apparatus the author has investigated the disintegration of lithium with protons of 1,125,000 electron-volts energy. The yield of protons is found to increase rapidly at first and afterwards increases with the 3/2 power of the energy, which indicates that the latter increase is merely due to the increased penetration of the protons into the lithium. Thus it is probable that the chance of disintegration is independent of the energy above 400,000 volts. A theoretical formula: $\mathrm{N} = k'\mathrm{V}e^{-a/\mathrm{V}^{\frac{1}{2}}}$ is deduced, where N = the yield, V = the energy, and k' and a are constants, and this agrees very well with the results. The radius of the lithium nucleus, as calculated from this, appears to be about 4 × 10^{-13} cm. The calculated effective cross-section for disintegration is given as 1·4 × 10^{-14} cm. The results at the lower energies agree with those of Cockcroft and Walton. J. E. R. C.

1836. Neutron and its Properties. J. Chadwick. *Brit. J. of Radiology,* 6. *pp.* 24–32, *Jan.,* 1933.—A concise account of the discovery and the properties of the neutron. F. C. C.

1837. Diffusion of Neutrons. Inelastic Shocks on the Nucleus. P. Auger. *Comptes Rendus,* 196. *pp.* 170–172, *Jan.* 16, 1933.—It has already been recorded that the radiation from beryllium bombarded by α-rays give rise in hydrogen in a Wilson chamber to two tracks, one due to rapid protons and the other to protons of some hundreds or tens of ekV. The latter are supposed to be due to slow neutrons [see Abstract 4378 (1932)] formed by the diffusion of fast neutrons through surrounding matter. Experiments have been carried out to test the effect of neighbouring matter on the number of short tracks. Shielding the source by paraffin wax blocks reduced the number of short tracks, while with the source so shielded from other neighbouring matter and a thick copper block behind it the number of short tracks increased. It is therefore concluded that the short tracks are due to slow neutrons resulting from the diffusion of the fast ones through matter. The shocks of the neutrons with the scattering nuclei are inelastic, γ-rays being emitted and very fast β-rays as observed by Joliot and Curie. From the point of view of the energy levels of the nucleus it would appear (1) that there is a level very little less in value than the energy of the fast neutrons, and (2) that there is a spectrum of nuclear levels which the neutrons can excite until reduced in energy below the lowest level. Experiments with lead indicate that neutrons can suffer elastic shocks with such heavy nuclei. J. E.

1838. Theory of Diffusion of Neutrons. J. Solomon. *Comptes Rendus,* 196. *pp.* 607–609, *Feb.* 27, 1933.—The applicability of Born's first approximation to the equation $V(r) = Ze^2e^{-r/\varrho}/r$ for the energy of interaction between an electron and a neutron is shown to extend only to the case of hydrogen. [See Abstract 556 (1933).] C. A. S.

1839. Neutrons. K. K. Darrow. *Rev. Sci. Instruments,* 4. *pp.* 58–64, *Feb.,* 1933.—The author gives a survey of the work which led to Chadwick's identification of neutrons with the radiation artificially excited from beryllium. A critical account is given of recent work upon the neutron. J. E. R. C.

1840. Emission of Neutrons from Light Elements Produced by α-Particle Bombardment. Irène Curie and F. Joliot. *Comptes Rendus,* 196. *pp.* 397–399, *Feb.* 6, 1933.—Using a methane filled ionisation chamber the authors have studied the excitation curve for the artificially excited radiation from the following elements : beryllium, boron, lithium, aluminium, and fluorine. Excitation from beryllium commences at an α-particle energy of $1\cdot3 \times 10^6$ electron volts while the figure for boron is 2×10^6 electron volts. The excitation passes through a maximum for an α-particle energy of $2\cdot6 \times 10^6$ electron volts for beryllium and $2\cdot2 \times 10^6$ electron volts for boron. A minimum occurs at an energy of $3\cdot2 \times 10^6$ electron volts for beryllium and $2\cdot85 \times 10^6$ electron volts for boron and afterwards it increases with the α-particle energy. The radiation (neutrons + protons) from lithium is small and commences at an α-particle energy of 3×10^6 electron volts and neutrons are definitely present in the radiation when the α-particle energy reaches 5×10^6 electron volts. Neutrons have also been observed in the radiation from aluminium and fluorine, and it is deduced that nuclei can disintegrate either with the emission of neutrons + protons or else with protons only. J. E. R. C.

1841. Chemical Nature of the Neutron. P. Achalme. *Comptes Rendus,* **196.** *pp.* **614–616,** *Feb.* **23, 1933.**—The author discusses the conception of the neutron, and then adopts an idea of his dating from 1912 in which the absolute value of the charge of the negative electron is double that of the positive charge on the proton (the unit of matter). This postulate does not contradict any experimental data, and by its aid the atomic series is shown to commence and proceed as follows: (1) Proton, possessing one positive charge. (2) Neutron with two protons and one electron. (3) The body X_3 with three protons and one electron, and possessing a net unit positive charge. (4) α-particles, with 4 protons and one electron, thus exhibiting a double positive charge and transformed into a neutral helium molecule by fixation of an extra-atomic electron. H. H. Ho.

1842. Structure of Atomic Nuclei. W. Heisenberg. *Zeits. f. Physik,* 80. 9–10. *pp.* 587–596, *Feb.* 16, 1933.—In continuation of a former paper [see Abstract 5066 (1932)] the author discusses atomic nuclear structure using Thomas-Fermi methods. The scattering of γ-radiation by nuclei and the nature of neutrons are also discussed. J. E. R. C.

1843. Production and Application of Fast Corpuscular Rays (Artificial Disintegration of Atoms). A. Brasch. *Naturwiss,* 21. *pp.* 82–86, *Feb.* 10, 1933.—This paper consists of an official summary of the results achieved up to the present by Brasch, Lange and Urban at the installation, erected in 1926 on Mount Generoso, for the artificial production of very fast kathode rays and canal rays. The most important features of the work may be classified under the following headings: (*a*) Description of the apparatus first erected for the production of high voltages from atmospheric thundercloud fields.; (*b*) Construction of high-voltage vacuum discharge tubes for use with impulsive discharges; (*c*) Biological and medicinal applications of fast, artificial β-rays; (*d*) Excitation of fluorescence with fast kathode rays; (*e*) The artificial disintegration of atomic nuclei (including lead) by canal rays. J. E. K.

1844. Amplification of the Ionisation Produced by Radioactive Sources. J. A. C. Teegan. *Nature,* 131. *pp.* 277–278, *Feb.* 25, 1933.—A special valve circuit for measuring small currents is described. The circuit can be adjusted so that 1 scale division of the galvanometer (having a normal rating of 10 divisions per microampere) corresponds to a variation in the ionisation current of 2×10^{-15} ampere. No disturbances due to electromagnetic effects have been encountered and the zero keeps steady over long periods. Since only 6 volts are applied to the anode, large capacity cells may be used to minimise fluctuations in the normal anode current. F. C. C.

See also Abstracts 1673, 1859, 1927, 1951, 2002.

RADIATION.

ABSORPTION AND TRANSMISSION.

1845. Pleochroism of Calcite in the Infra-Red. P. le Roux. *Comptes Rendus*, 196. *pp.* 394–396, *Feb.* 6, 1933.—K_o, K'_o, the coefficients of absorption of calcite for light propagated parallel and perpendicular to the axis for $\lambda\, 2\cdot 2$ to $4\cdot 4\ \mu$, vary respectively from $0\cdot 6$ to $30\cdot 7$, and from $0\cdot 7$ to $34\cdot 8$, with maxima at $3\cdot 4$ and $4\cdot 0\ \mu$, K_o being always slightly $< K'_o$. C. A. S.

See also Abstract 1867.

COLORIMETRY.

1846. Saturation Scale for Yellows. D. B. Judd. *J.O.S.A.* 23. *pp.* 35–40, *Feb.*, 1933.—Describes an investigation of the saturation scale for colours of which the dominant hue is $575\ m\mu$, using the Lovibond tintometer glasses (yellow series). It is found that the shape of the curve connecting purity (the stimulus quantity) with saturation (the sensation quantity) is unaffected by the size of the step used to determine it. Large steps, however, result in greater individual variations. It is concluded that the integral of the sensibility to purity change from zero purity may safely be taken as the saturation of the yellow colour sensation evoked. The curve connecting saturation and purity is compared with that obtained from two empirical relations and in one case the agreement, while not close, is better than that given by a straight line relationship. J. W. T. W.

See also Abstracts 1866, 1917, 1918.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

1847. Molecular Theory of Simultaneous Optical Effects of Magnetic Rotatory Polarisation and Magnetic Birefringence. G. Dupouy and M. Scherer. *Ann. de Physique*, 19. *pp.* 5–46, *Jan.*, 1933.—A molecular theory of the superposition of magnetic rotatory polarisation and magnetic birefringence in strong magnetic fields is developed for the general case when the direction of propagation of the light is oblique to that of the field. The external field is considered not only to modify the electronic orbits, but also to produce molecular orientation. Applying Maxwell's equations, equations for the indices of propagation and for the surface of indices are obtained, and for the particular cases where the direction of propagation is parallel or perpendicular to the field, these are identical with the classical results for the Faraday and Cotton-Mouton effects. In other directions, the medium transmits two privileged elliptical vibrations of opposite sense with crossed axes. In fields actually obtained, Gouy's rule and Verdet's law are still applicable. A study of the surface of indices shows how the existence of rotatory power modifies the two sheets of the surface progressively as the direction of propagation changes from normal to parallel to the magnetic field. [See following Abstract.] C. B. A.

1848. Wave-Surface in a Liquid under the Influence of a Magnetic Field. A. Cotton. *Ann. de Physique*, 19. *pp.* 47–58, *Jan.*, 1933.—Experiments on the superposition of magnetic birefringence and magnetic polarisation show that Cornu's theory of the wave-surface in a liquid placed in a magnetic field is untenable. The true wave-surface can be deduced from the surface of indices for the same medium as investigated by Dupouy and Schérer [see preceding Abstract]. The two surfaces are polar inverses of each other, and the wave-surface consists of two sheets to which no tangent plane having two distinct points of contact with the surfaces can be drawn. This result holds even when the magnetic birefringence is negligible (*e.g.*, CCl_4). The two sheets are then tangential along a circle in the equatorial plane, and the surface of indices is a surface of revolution of the fourth degree. C. B. A.

1849. Paramagnetic Properties of Crystals of the Rare Earths. H. A. Kramers. *K. Akad. Amsterdam, Proc.* 35. 10. *pp.* 1272–1281, 1932. *In French.* A previous analysis explained the general form of the law governing paramagnetic rotation as a function of the field and the temperature. The present paper contains an extension of the theory. [See Abstracts 1814–1817 (1930)]. G. E. A.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

1850. Quantitative Study of the Inhibiting Action of Certain Ions on the Fluorescent Power of Uranine. J. Bouchard. *Comptes Rendus,* 196. *pp.* 485–487, *Feb.* 13, 1933.—By means of the Perrin fluorometer, the influence of various alkali salts on the fluorescence of uranine in aqueous solution has been studied. With a constant salt concentration, provided this is not too high, the fluorescent power is a decreasing exponential function of the concentration of the fluorescent substance, the exponential coefficient k being the same as in absence of salt. With a constant concentration of the fluorescent substance, the fluorescent power is a decreasing exponential function of the salt concentration, the coefficient h depending on the nature of the salt. If concentrations are expressed in gm. per litre, the value of k is 0·488, and the values of h for the ions of sodium or potassium salts are: S, 0·153; CNS, 0·1; I, 0·069; S_2O_4, 0·022; S_2O_3, 0·021; NO_2, 0·016; AsO_3H, 0·012. T. H. P.

1851. Influence of Temperature on the Extinction of the Fluorescence of Dyes by Electrolytes. A. W. Banow. *Zeits. f. phys. Chem.* 163. *Abt.A.* 3–4. *pp.* 172–184, *Feb.*, 1933.—The theory of the extinction of the fluorescence of dyes by electrolytes by means of shocks of the second type leads to the consequence that rise of temperature must enhance the extinction. The supposition that the extinction is produced by the influence of the electrolyte on the activity of the dye leads, however, to the opposite conclusion. One series of experimental results is in accord with the former conclusion and another with the latter. The existence of two causes for the extinction is thus confirmed. In cases where shocks of the second order between the excited molecules and ions are lacking, experiment indicates that the order of the influences of ions on the fluorescence intensity corresponds with the order of hydration of the ions.

T. H. P.

See also Abstract 1743.

INTERFERENCE. DIFFRACTION AND SCATTERING.

1852. Influence of Dispersion on the Indications of the Haber-Löwes Gas Interferometer. E. Karwat. *Zeits. f. Instrumentenk.* 53. *pp.* 12–21, *Jan., and pp.* 70–78, *Feb.*, 1933.—Dispersion of light leads to much uncertainty in refractive index determinations for high molecular gases such as heavy hydrocarbons. The nature and magnitude of the dispersion effect for the most important gases has been found, and on the basis of these results a method for the adjustment of the interferometer and the interpretation of the observations is described. This method applies for white light with the Haber-Löwes interferometer, but it also holds for other interferometers. The usual method in determining the refractive index with white light in the Haber-Löwes interferometer proceeds on the assumption that the difference of the refractive index for light of mean wavelength is proportional to the number of displaced fringes, and a measurement is made with a compensating screw to restore the fringes to the zero position in the field. This, however, is not true in practice. The possible causes of inequality in the displacement are discussed. Empirical equations are established by which one can calculate for the known dispersion of the gas and compensator glass the absolute value of fringe displacement, and this agrees well with observed values. It is also shown how the calculation may be made for gaseous mixtures. Further, it is shown how the whole dispersion curve can be obtained approximately if the refractive index for white light and the absolute number of fringe displacement are known. The method of adjustment of the interferometer and the interpretation of the results under consideration of the displacement effect are then described and an example is quoted.

R. S. R.

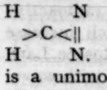
See also Abstracts 1875, 1909.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

1853. Photochemical Reactions of Oxalates with Bromine and with Iodine. Part I and II. R. O. Griffith, A. McKeown and A. G. Winn. *Faraday Soc., Trans.* 29. *pp.* 369–395, *Feb.*, 1933.—The photochemical reactions taking place between oxalates and bromine and iodine when illuminated by light of different wave-lengths are studied. The reaction vessels were of quartz and the illumination was furnished by a quartz mercury arc. Filters were employed to obtain light of certain definite wave-lengths. The results are interpreted in terms of reaction mechanisms, the effective primary process being the photo-dissociation of the trihalide ion, the free halogen acting as an internal light filter.

F. J. B.

1854. Primary Photochemical Processes. Part II. Absorption Spectrum and Photochemical Decomposition of Diazomethane. W. Kirkbride and R. G. W. Norrish. *Chem. Soc., J. pp.* 119–126, *Feb.*, 1933.—The absorption spectrum of diazomethane vapour shows two absorption regions : (1) From 4710 to 3200 Å., consisting of diffuse bands followed by a continuum, and (2) a completely continuous region, beginning at 2650 Å. The general character of the spectrum supports the formula



$\overset{H}{\underset{H}{>}}C<\overset{N}{\underset{N.}{\|}}$

Kinetically the photochemical decomposition of diazomethane is a unimolecular reaction in which the main products are nitrogen, ethylene, propylene, and a non-volatile liquid which is possibly a pyrazoline derivative. The quantum efficiency is approximately 4 at both 365 and 436 mμ. From these facts and from the photochemical behaviour of mixtures of diazomethane with hydrogen and with oxygen, it is concluded that the primary process in the photochemical decomposition is $CH_2N_2 + h\nu = CH_2 + N_2$. The formation of the actual products of the reaction is readily explainable by means of subsequent secondary processes. [For Part I see Abstract 3975 (1932).] T. H. P.

1855. Photochemical Action of Complex Radiations. C. Winther. *Zeits. f. wiss. Phot.* 31. 8–9. *pp.* 251–264, *Feb.*, 1933.—The results of Padoa and Vita (*Gazz. Chim., Ital.*, 54. p. 147, 1924 ; 56. pp. 164, 375, 1926 ; 58. pp. 3,647, 1928) are criticised, several sources of error in the methods used being indicated. A new procedure, devised to avoid such errors, is described and this has been applied to a study of the photochemical oxidation of hydrogen iodide by red, green and blue lights. The results indicate the additivity of the separate effects. T. H. P.

1856. Comparison of the Photographic Elementary Processes in Alkali and Silver Salts. R. Hilsch and R. W. Pohl. *Zeits. f. Physik*, 77. 7–8. *pp.* 421–426, *Aug.* 6, 1932.—Using methods developed earlier [see Abstracts 379 and 1206 (1932)] a comparison is made of the photochemical changes taking place during the formation of the latent image for alkali and silver salts. The processes are concluded to be identical, in both cases there being a transference of an electron from an anion to a neighbouring kation. A. H.

1857. Latent Image and Physical Development. Part III. H. Arens. *Zeits. f. wiss. Phot.* 31. *pp.* 125–130, *Sept.*, 1932.—A test is made of the hypothesis that the amount of silver developed is dependent only on the number of nuclei present. It is shown that the assumption is valid only when the order of mass of the nuclei is 10^{-15} gm. or less. [For Parts I and II see Abstracts 4178 (1931) and 4269 (1932).] A. H.

1858. Development of the Latent Image. C. Jausseran. *Comptes Rendus*, 196. *pp.* 341–343, *Jan.* 30, 1933.—The author shows that for a given exposure and development the density of the image on a photographic emulsion depends upon the time which has elapsed between the exposure and the development. This effect is independent of the colour of the light to which the plate is exposed, but the magnitude of the difference depends upon the developer. Normally the more intense image is produced by the elapse of the greater time between exposure and development, but for certain plates the reverse is the case. The effect appears to be attributable to some substance which can be washed out of the emulsion with water or alcohol. The effect of reducing and fixing agents is investigated. It is noted that given two images of the same intensity, but for which different times have elapsed between exposure and development, differences in the sizes of the grains will be observed. J. E. R. C.

1859. Influence of Grain Condition on the Blackening Sensitivity by Exposure to α-Particles. Marietta Blau and Herta Wambacher. *Zeits. f. wiss. Phot.* 31. 8–9. *pp.* 243–250, *Feb.*, 1933.—Photographic layers exposed to short-wave Röntgen and radioactive radiations give blackening curves the initial values of which increase in proportion to the absorbed energy and fulfil the Bunsen-Roscoe Law, whilst the same layers exposed to visible light show a variation with wavelength and do not satisfy the Bunsen Law [see Abstract 530 (1929)]. It has recently been shown by other authors, that treatment of the layers with desensitisers or chromic acid solution before exposure to such radiations rich in energy, gave rise to the same results as have been obtained for visible light, but the results are not consistent, due possibly to errors introduced by the strong absorption of the α-particles by the gelatin. Experimental results obtained by the present authors on photographic layers of different states of ripening show that although a ripened layer is 16 times more sensitive than an unripened layer when exposed to visible light, yet, for Röntgen rays and α-particles, the difference is reduced to a small percentage. Using the " grain free " emulsions of Lüppo-Cramer which are approximately 10^6 times less sensitive than the normal diapositive plates, it is shown that with α-particles from two polonium preparations, similar results are obtained as for normal plates and visible light. These can be explained by considering two possibilities—the freed silver atoms per grain are insufficient to produce a developable nucleus, and a large number of the freed atoms are changed into silver bromide by regression or other phenomena. The latter possibility should give rise to a sensitivity increase when the plate is treated with a bromide acceptor such as sodium nitrite, but the results actually show a sensitivity reduction under these conditions, again also illustrating the previous effects, the results obtained being capable of explanation by considering the ionisation conditions of the sodium nitrite salt. Finally, although the nucleus-free emulsion is very insensitive to γ-radiations, after treatment with sodium nitrite an increase in sensitivity is obtained as with visible light. R. C. F.

1860. Recent Developments in Infra-Red Photography. O. F. Bloch. *Roy. Soc. Arts, J.* 81. *pp.* 262–272 ; *Disc.*, 273–275, *Feb.* 3, 1933. —A résumé is given of the history of the sensitising of plates to the infrared, and the theory of optical sensitising is discussed. The uses to which plates sensitised for the region λ7500–λ8600 can be put are considered, and the results of examinations of the reflecting power of fabrics, and of the transparency of wood, are given in detail. Various scientific uses are mentioned, and results are given which have recently been obtained in astronomy by means of this method of sensitisation. In the *Discussion*, **R. Robertson** pointed out that whilst a great advance had recently been made it was necessary to remember that only a very small encroachment had been made upon the infra-red, and that were this region brought within the photographic range then big advances in our knowledge of molecular structure would be possible. A. H.

1861. Herschel Effect as a Result of Simultaneous Forward and Reverse Reactions. K. M. Joehnck and J. M. Blair. *J.O.S.A.* 23. *pp.* 67–69, *Feb.*, 1933.—In earlier work it has been found possible to account for the rate of growth of the latent photographic image by means of the hypothesis that the photographic reaction consists of forward and reverse reactions proceeding simultaneously. The attempt is now made to explain the Herschel effect on the basis of this assumption. The experiments described support the hypothesis. A. H.

1862. Modification of the Chronophotographic Method and Applications. E. Crausse and J. Baubiac. *Comptes Rendus,* 196. *pp.* 466–468, *Feb.* 13, 1933.—In the modified apparatus the displacements are recorded on a moving film. Measurements of the distribution of velocities within a liquid contained in a vertical cylindrical tube are described ; agreement with the theoretical curve is excellent if the duration of the exposure does not exceed a certain value. The method may be applied also to the determination of eddy frequencies ; the results quoted agree well with those obtained by other methods. H. F. G.

1863. Photographic Emulsion : Mechanism of Hypersensitisation. B. H. Carroll and D. Hubbard. *Bureau of Standards, J. of Research,* 10. *pp.* 211–228, *Feb.,* 1933.—Confirming earlier work at the Bureau of Standards, hypersensitisation by bathing with ammonia is shown to consist of a selective increase in sensitivity for the spectral region of sensitisation by the dye. Hypersensitisation by a given solution is highly dependent on the dye and to a less extent on the emulsion ; for many commercial panchromatic emulsions, water is preferable to ammonia solutions for practical use. On bathing a photographic emulsion in a solution there is set up a membrane equilibrium which is shown by electrode measurements to obey the Donnan equation. As a result of an almost unique combination of properties, bathing with ammonia and drying leaves an emulsion with an excess of silver over halogen ; this is confirmed by chemical analysis of plates and baths used for hypersensitisation. Comparison of data on the effect of ammonia on sensitisation by known dyes with those of Research Paper 488 [see Abstract 196 (1933)] on the effect of silver ion concentration in the emulsion on the same dyes shows very close correspondence. There is satisfactory correlation between the photographic effects of ammonia treatment and those of excess silver in the emulsion ; other theories of hypersensitisation, which are discussed, are shown to be inadequate. Reports of hypersensitisation by hydrogen peroxide are shown to be the result of inadequate control experiments, but appreciable hypersensitisation by reducing agents was confirmed.
H. H. Ho.

1864. Improvements in Microphotography with Ultra-Violet Light. A. Köhler. *Naturwiss.* 21. *pp.* 165–173, *Feb.* 24, 1933.—After a brief discussion of the factors affecting the critical size of an object which can be viewed in the microscope using light of differing wave-lengths, the author describes apparatus whereby improvements are obtained in the illumination of the microscope and in the source of illumination. A new monochromator for ultra-violet light is described ; it consists of a spark-gap, a lens, and a prism all mounted on a base capable of rotation, and a second fixed prism, the light from this second prism falling on to a totally reflecting prism which acts as the microscope mirror. Clockwise rotation produces a reduction in the wave-length of the illumination, whilst anti-clockwise rotation increases its value. In order to maintain a steady spark and to reduce variations in spark length, an alteration in the electrode shape is introduced, the electrodes consisting of circular rings rotated by small electric motors. Finally, photograms are given illustrating the effect of rotating the electrodes, and of using a mirror to reflect the otherwise wasted light towards the lens, the effect of the form and size of the spark on its photographic action also being discussed. R. C. F.

1865. Comparator for Screen and Tone Negatives. H. M. Cartwright. *Phot. J.* 73. *pp.* 59–67 ; *Disc.,* 67–68, *Feb.,* 1933.—A description is given of a simple micro-photometer for measuring densities under workshop conditions ; the instrument can also be employed for evaluating the dots forming the image on screen negatives and positives. The use of the photometer for various processes is discussed. In the *Discussion,* **O. Bloch** expressed the opinion that a somewhat limited density range had been chosen for the instrument ; in his reply to **Ferguson** the author gave details of the preparation of the dot wedge ;

Davies suggested dispensing with the dot wedge and measuring the dot size in terms of the apparent density when the image was put out of focus. A. H.

See also Abstracts **1802, 1826, 1915.**

PHOTOMETRY.

1866. Proposed Scale for Specifying the Chromaticity of Incandescent Illuminants and Various Phases of Daylight. I. G. Priest. *J.O.S.A.* 23. *pp.* 41–45, *Feb.*, 1933.—Instead of using the temperature T of a black body the radiation from which matches in colour the light given by an incandescent illuminant or by a phase of daylight, to specify the chromaticity of the latter, it is suggested that the reciprocal (1/T) should be adopted. Experimentally a just perceptible difference of colour of two black body distributions corresponds to a difference in (1/T), which is nearly independent of temperature. Furthermore, in many calculations, *e.g.*, when using Wien's or Planck's equation, it is more convenient to work with 1/T than with T. W. S. S.

1867. Colour Filters for Altering Colour Temperature. Pyrometer Absorption and "Daylite" Glasses. H. P. Gage. *J.O.S.A.* 23. *pp.* 46–54, *Feb.*, 1933.—If a colour filter has a density δ which varies with wavelength λ in accordance with the equation $\delta = (6223/\lambda)\ \Delta$ then it will convert a Wien distribution of energy corresponding to a temperature T_1 to one corresponding to a temperature T_2 where $\Delta = \frac{1}{T_1} - \frac{1}{T_2}\ (T_1 > T_2)$. This use of this result in developing red glasses for optical pyrometry and "daylite" glasses for raising the colour temperature of artificial illuminants, is explained in detail. A table is included giving the colour temperatures of artificial light sources and various phases of daylight based both on Wien's and Planck's equation. W. S. S.

1868. Recording Spectrophotometer for Infra-Red. K. Liese and K. Schaum. *Zeits, f. wiss. Phot.* 31. 8–9. *pp.* 217–242, *Feb.*, 1933.—Describes in considerable detail the construction and method of use of a spectrophotometer giving a photographic record of the spectral absorption curve of a medium such as a chemical solution. The instrument described is designed primarily for use in the infra-red (0·8 to 2μ). Examples of the results obtained are given in the paper. J. W. T. W.

1869. Black-Body Radiator for High Temperatures. C. Müller, H. Theissing and W. Esmarch. *Zeits. f. techn. Physik,* 14. 3. *pp.* 107–110, 1933.—Describes the construction and mode of operation of a black-body (total) radiator suitable for use up to 3000° A. It is heated by means of an induction furnace taking power up to 10 kilowatts at 10,000 cycles. The radiator itself consists of a tungsten cylinder viewed through a thorium oxide diaphragm 6 mm. in diameter. The cylinder is 30 mm. long and its walls about 4·5 mm. thick. It operates in an atmosphere of nitrogen at a pressure of about 50 mm. It is suggested that this form of black-body might be used to investigate the Waidner-Burgess form of primary standard of light, *i.e.*, the brightness of a black-body held at the freezing point of platinum. J. W. T. W.

See also Abstract 1916.

POLARISATION.

See Abstracts **1909, 1911.**

RADIATION, EMISSION.

1870. Earth Magnetic Effect and Corpuscular Nature of Ultra-Radiation. Part IV. J. Clay. *K. Akad. Amsterdam, Proc.* 35. 10. *pp.* 1282–1290, 1932.—Observations of cosmic radiation were made with an instrument which was carried on board ship from Genoa to Batavia after standardisation in Amsterdam. The instrument was surrounded by iron 13 cm. thick. The indicating needle was connected to an electrometer and the charge on the electrometer due to the ionisation current was compensated by an induced known charge of opposite sign. The position of the needle was photographed at hourly intervals. The intensity of the ultra-radiation diminishes with the magnetic latitude. When the observations of other experimenters are included, the intensity curve runs horizontally from the magnetic north pole to Amsterdam, diminishes towards the magnetic equator by 16 %, and then increases towards the south magnetic pole. Reasons are set forth for the conclusion that cosmic rays have the nature of charged corpuscular radiation. [See also Abstracts 188 and 1299 (1931).] G. E. A.

1871. Compton's Latitude Effect of Cosmic Radiation. G. Lemaitre and M. S. Vallarta. *Phys. Rev.* 43. *pp.* 87–91, *Jan.* 15, 1933.—Commenting upon Compton's experimental observation that between latitudes 34° north and south of the equator the intensity of the cosmic radiation drops sharply to about 87 % of its value elsewhere, the authors show that provided that cosmic radiation consists of charged particles this variation may be attributed to the earth's magnetic field. Taking the earth's field as being equivalent to that of a doublet, the equations of motion of a charged particle moving in it are deduced and the resulting intensity distribution on the earth's surface due to the influx of particles from all directions is calculated. It is shown that there are three possibilities: (1) no incident particles can reach the earth's surface; (2) all incident particles reach the surface; (3) only certain directions are allowed and these are contained within a certain cone. The particles, assumed to consist of either electrons or protons, are calculated to have an energy of about 10^{10} electron-volts. J. E. R. C.

1872. Mechanism of Acquirement of Cosmic-Ray Energies by Electrons. W. F. G. Swann. *Phys. Rev.* 43. *pp.* 217–220, *Feb.* 15, 1933.—It is shown that the growth of stellar magnetic fields such as occur in sunspots can give rise according to Faraday's law of electromagnetic induction to electric fields capable of giving electrons energies corresponding to 10^{10} volts. Moreover, the rate of acquirement of energy can reasonably be greater than the rate of loss by collisions with atoms. It would be difficult to realise energies as high as 10^{10} volts from the magnetic fields of spots such as occur on the sun. Energies corresponding to 10^{9} volts are, however, within the range of possibility, and it is suggested that electrons projected from such spots may play a part in auroral phenomena. For cosmic rays one must, however, probably look to the stars for the necessary conditions. Because of the repulsion of the current responsible for the magnetic field, the electron is hurled away from the spot as it acquires its energy. AUTHOR.

1873. Magnetic Deflection of Cosmic Corpuscles in the Wilson Chamber. P. Kunze. *Zeits. f. Physik*, 80. 9–10. *pp.* 559–572, *Feb.* 16, 1933.—A Wilson chamber is placed in a magnetic field produced by an air coil absorbing 500 kW [see Abstract 581 (1933)]. The cloud tracks due to the corpuscles are curved to the right or to the left according to the sign of the charge on the corpuscle. On 75 plates a total of 90 tracks is obtained consisting of 61 single tracks, 13 doubles and a triple. The multiple tracks are to be discussed in a later paper: only the energy distribution is considered here. The fastest measured particle has an energy of 2660×10^6 volts; two other particles are estimated to have energies of about 3200×10^6 and 9200×10^6 volts respectively. Positive and negative particles occur with about equal frequency. The energy spectrum shows no marked peculiarity, but decreases continuously in intensity towards the direction of higher energy. Photographic reproductions of many of the tracks are given. F. C. C.

1874. Energy Stream of Cosmic Radiation. E. Regener. *Zeits. f. Physik*, 80. 9–10. *pp.* 666–669, *Feb.* 16, 1933.—The total energy which, in the form of cosmic radiation falls upon 1 sq. cm. per sec. at the limits of the atmosphere is $3{\cdot}53 \times 10^{-3}$ erg. cm.$^{-2}$ sec.$^{-1}$, or on the whole surface of the earth the incident energy stream from this source is $1{\cdot}8 \times 10^{16}$ ergs. per sec. This energy stream is approximately the same as that which in the form of light and heat comes from the fixed stars. The influence of these facts on the temperature of interstellar space is discussed. J. J. S.

See also Abstract 1869.

RADIATION, GENERAL THEORY.

See Abstracts 1758, 1787.

REFLECTION. REFRACTION AND DISPERSION.

1875. Variation of Phase by Reflection from Thin Metallic Films. P. Rouard. *Comptes Rendus*, 196. *pp.* 339–341, *Jan.* 30, 1933. —Earlier investigators of the change in phase produced by reflection at a thin metallic film have obtained very discordant results. The author uses a wedge of silver on glass, produced by using an asymmetric disposition in a sputtering chamber, and examines the interference effects produced between light reflected from the glass and light reflected from the different regions of the silver. The fringes obtained are very feeble, and the discordant results of earlier workers are attributed to this fact. A table showing the relation between the phase change and the thickness of the silver is given and it appears that the phase change is a retardation for very thin films ($0{\cdot}5\ m\mu$) which increases as the film thickness increases. For each wave-length it passes through a maximum and then gradually changes to a phase advance which also passes through a maximum, finally decreasing to a steady value of approximately $0{\cdot}30\lambda$. J. E. R. C.

1876. Geometrical Optics. C. W. Oseen. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 23. 2. *pp.* 1–49, 1933. *In German.*—In continuation of previous work, Parts I and II [see Abstract 4922 (1932)], the properties of the evolute of a surface in the neighbourhood of a focal point are investigated by ordinary geometrical methods on the assumption that not all the coefficients of the third order terms in the equation to the surface vanish. C. B. A.

1877. Theory of the Dispersion and Absorption of Helium. J. A. Wheeler. *Phys. Rev.* 43. *pp.* 258–263, *Feb.* 15, 1933.—Herzfeld and Wolf were able to conclude from the behaviour of the refractive index of helium in the visible spectrum that the continuous absorption of the gas below the 507Å series limit plays an essential part in producing the observed refractivity. The present investigation involves a quantum mechanical calculation of the actual strength of this continuum, and also of the resonance line at 584Å. As a by-product, the atomic absorption coefficient for X-rays is computed. The accuracy of the calculations is discussed. The 30 % deviation from the present value of Vinti's value for the strength of the resonance line is accounted for. The *f* sum rule is verified to 2 % and the experimental refractive index is checked within 3 %. It is discussed why the continuous spectrum is relatively so much stronger in helium than in hydrogen and the alkali metals. AUTHOR.

1878. " Univertor " Principle in New Form. J. Flügge. *Zeits. f. Instrumentenk.* 53. *pp.* 78–80, *Feb.*, 1933.—A modification in the mechanical construction of the universal vertical illuminator for microscopes, previously described [see Abstract 224 (1933)], allows of a much simpler transition from bright to dark field illumination. C. B. A.

1879. New Method of Measurement of the Thickness of Metal Films. S. Tanaka. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 91. *pp.* 293–306, *Jan.*, 1933. *In English.*—The estimation by weighing of the thickness of a thin metallic film chemically deposited or sputtered on glass is open to the objection that the density of such a film is not necessarily that of the metal in the mass. The thickness of films thicker than 0·05 micron can also be determined by the interference method, but the necessary allowance for the difference of phase changes on reflection is doubtful. A recent method [see Abstract 136 (1932)] employing interference of X-rays is reliable, but is only applicable to extremely thin films having a very uniform surface. The new method is applicable down to thicknesses less than 0·01 micron, and can be used even when the metallic surface is somewhat granular. The image of a lattice of parallel straight lines is formed by a contracting microscope on the boundary of the film part of which has been scraped away so as to expose the glass below. The lines are formed perpendicular to the straight boundary between the film and the exposed glass. The displacement between the images of the lines after reflection from (*a*) the metallic film and (*b*) the glass is photographed using a microscope the axis of which is perpendicular to that of the contracting microscope, both microscopes being inclined at 45° to the film. The two images are not quite continuous and a lateral separation less than that resolvable between two parallel straight line images can be measured. The derivation of the thickness of the film from measurements on the photograph is treated in detail. Photographs are reproduced. P. H. B.

See also Abstracts 1671, 1688, 1691, 1701, 1748, 1852, 1864, 1913, 1914, 1999, 2000, 2001, 2060.

SPECTROSCOPY.

1880. Arc Spectrum of Iodine. S. C. Deb. *Roy. Soc., Proc.* 139. *pp.* 380–397, *Feb.*, 1933.—The spectrum of iodine has been photographed in the region λ 3200 to λ 9113 in emission, and in the region λ 2300 to λ 1800 in absorption. The transitions ($5p$—$6s$), ($6s$—np) and ($6p$—ns) have been identified from the data obtained by the author, from which the ionisation potential of iodine has been found to be 10·548 volts. Altogether 160 lines out of a total of 437 recorded lines have been classified. AUTHOR.

1881. Development and Present State of Quantitative Spectrum Analysis. Part I. Fundamentals and Procedure. F. Waibel. *Zeits. f. Metallkunde*, 25. *pp.* 6–12, *Jan.*, 1933.—A general account is given of the theory and methods of production of flame spectra and spark spectra of solutions and between solid electrodes, and of the applications of these methods in quantitative analysis. H. F. G.

1882. Absorption Spectra of Complex Chromium Salts. G. Joos and K. Schnetzler. *Zeits. f. phys. Chem.* 20. *Abt.B.* 1–2. *pp.* 1–10, *Feb.*, 1933.—The absorption line-spectra of about 40 chromium complexes have been investigated. For most salts which give sharp lines, the alteration is quantitatively related to the Cr^{+++} ion, but in hexacyan and hexarhodan complexes it is only qualitative. F. S.

1883. Changes Produced by a Dissolved Substance on the Infra-Red Absorption Spectrum of a Solvent. Part I. Influence of Dissolved Salts on the State of Association of Solvent Water. R. Suhrmann and F. Breyer. *Zeits. f. phys. Chem.* 20. *Abt.B.* 1–2. *pp.* 17–53, *Feb.*, 1933.—By dissolving various salts, which themselves had no absorption bands in the short-wave infra-red region, the authors have found that the absorption bands of water are changed in two ways. The solution of some salts, such as alkali halides, causes the water bands to be steeper and slightly displaced to shorter wavelengths (depolymerisation effect). This effect is produced both by anions and by kations and, in general, increases with increasing ionic radius. Other bands due to hydration of solute molecules or ions are found; for these the hydration effect for the same anion is dependent on the radius and valency of the kation. The other type of change in the water bands occurs when salts, *e.g.*, $MgCl_2$, $AgNO_3$, K_2HPO_4 are dissolved; the bands are rounded off as well as displaced. This appears to be due to a dependence between the depolymerisation effect and the chemical influence of the water molecules on the one hand, and the hydration pressure and volume concentration of water in the solution on the other hand. W. R. A.

1884. Envelopes of Infra-Red Absorption Bands. S. L. Gerhard and D. M. Dennison. *Phys. Rev.* 43. *pp.* 197–204, *Feb.* 1, 1933.—The intensity formulæ for the fine structure absorption lines of molecules of the symmetrical rotator type are approximated by replacing the sums by integrals. The resultant expressions can be evaluated and used either to determine the intensity of an individual line or the envelope of all the fine structure lines. The envelopes of bands corresponding to parallel type vibrations contain P, Q, and R branches. The two characterising features of the envelope are the intensity of the zero branch and the doublet separation which give values of the moments of inertia A and C. Determinations of the envelopes of perpendicular-type bands have been made, limitations of the approximation are discussed, and relevant data are given for methyl halides. The carbon-halogen nuclear separations have been calculated, and the values so obtained are in good agreement with the values of Pauling. [See Abstract 3131 (1932).] W. R. A.

1885. Colour of Sulphuric Acid Solutions of Di- and Triphenylmethanes. L. C. Anderson. *Am. Chem. Soc., J.* 55. *pp.* 809–812, *Feb.*, 1933.—The absorption spectra of diphenylmethane, tetraphenylethane and triphenylmethane dissolved in a mixture of sulphuric acid and dimethyl sulphate are studied. The colour produced when triphenylmethane is dissolved in sulphuric acid is due to the formation of triphenylcarbinol sulphate. The absorption spectra of solutions of diphenylmethane in H_2SO_4 are similar to those of *sym*-tetraphenylethane in the same solvent, but the cause of this has not yet been demonstrated. C. B. A.

1886. Spectrum of the Discharge through Oxygen and Hydrogen Mixtures. A. S. Roy. *Phil. Mag.* 15. *pp.* 421–426, *Feb.*, 1933.—Mixtures of oxygen with a minute quantity of hydrogen are excited in a Geissler tube by a voltage of 15,000 volts. With pressures of less than 1 mm. of Hg, it is found that the lines of the secondary spectrum are approximately of the same intensity as when pure hydrogen is employed, but the lines of the Balmer series, especially the higher members, are strongly increased in intensity. With the same mixture of oxygen and hydrogen, at pressures of 3 to 4 mm., the lines of the secondary spectrum of hydrogen are extinguished, but the Balmer lines appear even stronger than at the lower pressures. A number of strong bands now appear, which are identified as the Ångström bands of carbon monoxide. An explanation of the phenomena is given, the strong appearance of the Balmer lines being explained by the theory of collisions of the second kind between oxygen atomic ions or molecular ions and hydrogen atoms. T. B.

1887. Absorption Spectra of Higher Oxides. A. K. Dutta and P. K. Sen Gupta. *Roy. Soc., Proc.* 139. *pp.* 397–405, *Feb.*, 1933.—Absorption spectra of N_2O_5, TeO_3 and MoO_3 have been studied. In all cases there is a first absorption, followed by a retransmitted patch of light, and then a second absorption. The first absorption has been interpreted as corresponding to dissociation into N_2O_4 and O (^3P), TeO_2 and O (^3P), MoO_2 and O (^3P) respectively, and the second absorption as corresponding to N_2O_4 and O $(^1D_2)$, TeO_2 and O $(^1D_2)$, MoO_2 and O $(^1D_2)$ respectively. The heat of dissociation of O_2 is found to be 128 k.cal. from the absorption of N_2O_5. AUTHORS.

1888. Energy Distribution in the Mercury-Arc Spectrum. L. B. Johnson and L. Burns. *J.O.S.A.* 23. *pp.* 55–59, *Feb.*, 1933.—Describes the results of a study of the effect of various factors on the energy emission in four regions of the mercury arc spectrum, *viz.*, 4000–1400–380–295–185 $m\mu$. Both high and low pressure arcs were investigated. In the former, the effect studied was that of change of arc voltage ; in the latter case, the effect of change of current was determined. The results are expressed in watts received per sq. mm. at a distance of 50 cm. from the arc, the radiation from the anode and kathode being included. J. W. T. W.

1889. Excitation Functions of Atomic Hydrogen. L. S. Ornstein and H. Lindeman. *Zeits. f. Physik*, 80. 7–8. *pp.* 525–533, *Feb.* 6, 1933.—Describes a method for measuring the excitation functions of the Balmer lines in atomic hydrogen. The experimental curves are compared with theory. A. D.

1890. Photographic Action of Lines in the Flame Spectra of the Alkali Metals. R. Bossuet. *Comptes Rendus*, 196. *pp.* 469–470, *Feb.* 13, 1933.—A drop of a solution of the salt is held in the oxy-acetylene flame on a stick of fused magnesium pyrophosphate. With a quartz spectrograph and rapid plates, the limiting quantities discoverable with a slit 0·045 mm. wide is $3 \cdot 10^{-7}$ mg. of lithium (line 6708·2). With sodium (D line) the quantity is even smaller. E. E. F. d'A.

1891. Perturbed Series in the Spectrum of Ionised Aluminium. L. Pincherle. *N. Cimento,* 10. *pp.* 37–42, *Jan.,* 1933.—Shenstone and Russell's theory of the mode of origin of certain types of perturbed series in line spectra [see Abstract **2849** (**1932**)] is tested by computing by a wave mechanics method the perturbation produced by a term $3p3p^1$D on terms of the series $3snd^1$D of the spectrum of ionised aluminium. Although the calculations can only give the order of magnitude of the perturbation of the lines from the values given by the Ritz formula, the results accord well with experiment and substantially confirm the Shenstone-Russell explanation. W. S. S.

1892. General Theory of the Broadening of Spectral Lines. W. Lenz. *Zeits. f. Physik,* 80. 7–8. *pp.* 423–448, *Feb.* 6, 1933.—The broadening of spectral lines must be treated as a problem of classical physics. It is only necessary to make a Fourier analysis of the temporally variable perturbed emission frequency of the atom which is caused by the passing perturbing gas atom. The case of perturbation by foreign gases is calculated under the simplifying assumption of an energy of interaction proportional to r^{-p}. For pressures up to about 1 atmosphere the modified Lorentz law gives the broadening and displacement proportional to the pressure and the asymmetry independent of pressure. The index p differs for different gases, but in general lies between 5 and 10. Since the necessary exact measurements of the asymmetry have not been made, only a few qualitative results of the theory can be confirmed in this respect. J. E. K.

1893. Some Integrals of Importance in the Theory of the Pressure Broadening of Spectral Lines. H. Jensen. *Zeits. f. Physik,* 80. 7–8. *pp.* 448–450, *Feb.* 6, 1933.—Some integrals are evaluated arising in the paper by W. Lenz on the pressure broadening of spectral lines. [See preceding Abstract.] J. E. K.

1894. Pressure Broadening of Spectral Lines. Part II. H. Margenau. *Phys. Rev.* 43. *pp.* 129–134, *Jan.* 15, 1933.—It is shown that the statistical method of calculating the pressure of broadening of spectral lines by foreign gases, which is given in Part I [see Abstract **3761** (**1932**)], must lead to the same result as the method by which the modulated frequencies are expanded as a Fourier Integral. The former results are extended and the distribution of frequencies within a spectral line broadened by foreign gases is calculated and gives an approximately closed expression and an accurate function which can be evaluated graphically. There is good agreement with experiment on the Hg line 2537 Å, though there is some ambiguity due to uncertainty of the values of the molecular constants of attraction. It is possible to determine these constants from analysis of the line contour. J. E. K.

1895. Interaction of Configurations: sd – p^2. R. F. Bacher. *Phys. Rev.* 43. *pp.* 264–269, *Feb.* 15, 1933.—It does not seem possible to account for the presence of singlets below their triplets in two-electron spectra simply from the ordinary exchange integrals. The exchange integrals seem to be essentially positive. It is shown that the matrix component of electrostatic energy connecting the $3s\ 3d\ ^1$D with $3p^2\ ^1$D in Mg I is sufficiently large to account for the occurrence of $3s\ 3d\ ^1$D below $3s\ 3d\ ^3D$ as observed experimentally. Analytic radial wave functions of the type developed by Slater are used in the calculation of the non-diagonal elements. AUTHOR.

1896. Theoretical Investigation of the Oxygen Atom in Various States of Ionisation. D. R. Hartree and (Miss) M. M. Black. *Roy. Soc., Proc.* 139. *pp.* 311–335, *Feb.* 1, 1933.—The energies of various states of OI, OII, OIII and OIV are calculated, and the ionisation energies and inter-multiplet separations are obtained. In view of the approximations necessary the agreement between observed and calculated values is considered satisfactory. The paper is entirely mathematical in character. A. H.

1897. Vibration Spectra and Molecular Structure of Methyl and Ethyl Alcohols. R. Titéica. *Comptes Rendus,* 196. *pp.* 391–394, *Feb.* 6, 1933.—The infra-red spectra of gaseous methyl and ethyl alcohols at low pressures have been measured from $\lambda\,12\cdot10$ to $\lambda\,14\cdot70\mu$, and compared with previous results [see Abstracts 1647 (1925) and 1871 (1929)], and with the Raman spectra. It is inferred that in methyl alcohol there are eight fundamental frequencies—four single, four double—implying a structure in which the distance C—H = 1·08, C—O = 1·46, O—H = 0·96 Å, and the angle between the directions of two CH linkages is 106°, while in ethyl alcohol O—O = C—C = 1·53 Å, and the angle between the linkages CC and CO = 108° 16′. C. A. S.

1898. Infra-Red Absorption Spectra of Organic Compounds and Constituents of Motor Spirits. C. F. Kettering and W. W. Sleator. *Physics,* 4. *pp.* 39–49, *Feb.,* 1933.—The absorption spectra for 25 compounds, of which 17 are typical of the important components of petrol and which include both chain and ring molecules, all in the vapour state, have been examined throughout the spectral range 1μ to 30μ, by using prisms of NaCl, KCl and KBr. The percentage absorption is shown graphically in the charts which follow as function of the wave-length for specified amounts of material. The curves indicate certain distinctive features characteristic of each different molecule, as well as bands common to several or all the compounds. The resolution was not sufficient to separate rotational lines in any of the bands. In addition to the hydrocarbons, eight other substances, tetraethyl lead (the only material studied in the liquid state), tetraethyl germanium, tetramethyl tin, and tetramethyl lead and also aniline, dicyclopentadiene, methyl nitrate and diethyl peroxide were investigated. They were included in the list on account of their influence upon the detonation of fuel in the petrol engine. AUTHORS.

1899. Effect of Crystal Symmetry and Chemical Composition on the Energy Levels of Solids. F. H. Spedding and G. C. Nutting. *Am. Chem. Soc., J.* 55. *pp.* 496-504, *Feb.,* 1933.—Experimental data for the absorption spectra and separations of the multiplet lines are recorded for hydrated crystals of the following salts: gadolinium ethyl sulphate, chloride, bromide, sulphate, bromate and nitrate. The spectra consist of lines which arise from electronic transitions from a single basic level $4f^7$, $^8S_{7/2}$, to excited levels which are non-degenerate through the influence of the electric fields of the neighbouring ions. The amount and nature of the splitting depend on the symmetry and separation of the ions in the lattice with higher symmetry corresponding to smaller separations of the levels. The spectra of monoclinic and hexagonal crystals show distinct differences; minor regularities are found in qualitative agreement with theoretical predictions, but these preliminary data are insufficient for any wide generalisations. N. M. B.

V. 19

1900. Ultra-Violet Absorption Spectra of Simple Benzene Derivatives. F. W. Klingstedt. *Zeits. f. phys. Chem.* 20. *Abt.B.* 1–2. *pp.* 125–141, *Feb.*, 1933.—The absorption spectra of bromo-, iodo-, and *p*-dibromo-benzene in hexane solution are quantitatively measured up to 2000 Å and compared with those of other benzene derivatives. The excitation energies of various simple benzene derivatives are calculated, and regularities in their variation are established. The absorption has been determined according to Henri's method. H. H. Ho.

1901. Auxochrome Effect. M. Horio. *Kyoto Coll. Eng., Mem.* 7. *pp.* 177–255, *Jan.*, 1933. *In German.*—The effect of substituting one or more of the groups $-CH_2CH_3$, $-CH=CH_2$, $-C\equiv CH$, $-NH_2$, $-OH$ or $-OCH_3$ on the electronic and vibration frequencies of the benzene nucleus is studied by an analysis of the absorption spectra of the vapours of styrol, phenylacetylene, ethyl benzene, aniline, phenol, anisol, *o- m-* and *p*-toluidines and *o-* and *p*-anisidines. The spectra exhibit regular fine structure and several fundamental intervals are recognised. C. B. A.

1902. Theory of the Continuous Spectrum of the Hydrogen Molecule. L. Goldstein. *J. de Physique et le Radium*, 4. *pp.* 44–53, *Jan.*, 1933.—The two nuclei of the hydrogen molecule are assumed to be coupled by a potential energy function as in the Morse model, and this leads to a determination of the energy levels and proper functions by wave mechanics. Transitions from any one of these levels to a final unstable state $1^3\Sigma$ are regarded as giving rise to the emission of the continuous bands of hydrogen. In the final state a de Broglie plane wave is taken to represent the motion of one nucleus with respect to the other. The distribution of intensity in the continuous bands is then estimated using approximate methods. It is found that the intensity decreases from the origin of the continuous spectrum in the far ultra-violet towards the long wave-lengths, and this decrease is very rapid. Experiment appears to confirm this behaviour. W. S. S.

1903. Potential Energy Curves of Mercury Hydride. R. Rydberg. *Zeits. f. Physik*, 80. 7–8. *pp.* 514–524, *Feb.* 6, 1933.—A method developed by the author [see Abstract 1978 (1932)] is used to construct potential energy curves for the molecule of mercury hydride. These curves provide a quantitative confirmation of the theory that the decomposition of the mercury hydride molecules is produced by rotation. W. R. A.

1904. Continuous Absorption Spectra of Polyatomic Molecules. Y. Hukumoto. *Tohoku Univ., Sci. Reports*, 21. *pp.* 906–927, *Dec.*, 1932. *In English.*—The absorption spectra of 27 alkyl halides are recorded; continuous absorption only is found. The long wave-length limit of each band moves towards the red with increasing pressure, up to a limiting value. All the spectra are of the same type, but the bands are displaced towards the longer wave-lengths on passing through the series chloride, bromide, iodide. Usually only one band is present, but with the iodides there are two or three bands, which in the case of the chlorides and bromides are probably beyond the range of the quartz spectrograph. The heats of dissociation of the C-H bonds are calculated from the wave-lengths of the absorption edges. H. F. G.

1905. Atomic Energy Levels and Zeeman Effect. D. R. Inglis and N. Ginsburg. *Phys. Rev.* 43. *pp.* 194–196, *Feb.* 1, 1933.—The present theory of complex spectra, neglecting magnetic interactions between electrons, has been successful enough in interpreting the data for certain simple configurations that it is of interest to discuss the extent to which this procedure can be applied to the energy levels and Zeeman effect of other configurations. The theory is extended to include p^5p, and comparison is made with experimental data. Greater discrepancies appear here than in simpler cases. This is an example of the greater importance of the neglected interactions in more complex configurations. E. E. F. d'A.

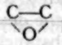
1906. Zeeman Effect in Solids. F. H. Spedding. *J. Chem. Phys.* 1. *pp.* 144–154, *Feb.*, 1933.—The transverse Zeeman effect on the absorption lines of the monoclinic $GdCl_3.6H_2O$ was examined at various field strengths. Photographs were made with the crystals at various temperatures. Enlarged reproductions and microphotometer curves are given. The results are discussed and explained on the assumption that if an electron is excited as a first approximation only its spin can orient in a magnetic field. **Errata,** *ibid. p.* 287, *April,* 1933. AUTHOR.

1907. Stark Effect for Xenon. H. W. Harkness and J. F. Heard. *Roy. Soc., Proc.* 139. *pp.* 416–435, *Feb.* 1, 1933.—A study is made of the Stark effect for xenon in the region λ3500–λ8400, a Hilger E1 spectrograph and a 30-ft. concave grating being employed. Appreciable displacements are observed for 98 lines, including a number of combination lines brought out by the field employed. The sharp, principal and fundamental series lines are, in general, displaced without splitting, while many of the diffuse series lines suffer large displacements and are split into a variety of patterns. The $5d_2$ and $6d_5$ terms are split without reference to electron spin, the resulting patterns being " normal " as in helium. The action of the field upon the other terms studied indicates that the *ls* coupling is retained, the *m* values being determined by the *j*'s. The displacements observed are attributed to the displacement of initial states ; whilst their sign and magnitude give no support to the idea that Stark displacements are governed by the hydrogen differences only, it is possible to find a qualitative explanation in the Pauli formula. As the field increases displaced components of certain lines decrease greatly in intensity, this being accompanied by the enhancement of components arising from nearby lines ; this unusual intensity relation shows up most clearly with $2p_i$—$4s_5$ and $2p_i$—5U, and persists for different values of *i*. No displacements are observed for the second spectrum of xenon. A. H.

1908. Bibliography of the Raman Effect, 1930-1932. S. C. Sirkar. *Indian Journ. Phys.* 7. *pp.* 431–469, *Dec.* 1, 1932.—The plan follows that in the earlier Bibliography [see Abstract 495 (1931)] and papers are included from the beginning of July, 1930, to the end of August, 1932, classified under subject headings. There is an author index, and against each author are given the letters indicating the sections in which his name appears. A critical compilation of the frequencies of all substances so far investigated is to appear later. A. C. M.

1909. Molecular Rotation in Liquids. S. P. Ranganadham. *Indian Journ. Phys.* 7. *pp.* 353–364, *Dec.* 1, 1932.—Depolarisation of the scattered light is spectroscopically determined for λλ4046 and 4358 mercury lines using the method of narrow and wide slits for 14 different liquids. The aggregate intensity of the rotation wing in relation to that of the pure

Rayleigh scattering is deduced. Good agreement is found with Manneback's theory for a large number of non-associating liquids, such as benzene. For highly viscous or associating liquids like salol or formic acid, the intensity of the rotation wing is far below the theoretically expected value, and it is suggested that this is due to the large impedance offered to rotation in such cases. The intensity-distribution in the rotation wing of benzene is studied in detail. There is a gradual falling off in intensity from a maximum near to the Rayleigh line, not in accordance with the view that a single benzene molecule is the scatterer. It is thought that it may be due to groups of molecules with a high moment of inertia.
A. C. M.

1910. Raman Effect with Derivatives of α-Ethylene Oxide. R. Lespieau and (Miss) B. Gredy. *Comptes Rendus*, 196. *pp.* 399–401, *Feb.* 6, 1933.—The principal Raman lines of 8 compounds containing the  group are tabulated. The introduction of a halogen atom close to the group does not influence the characteristic frequency at 1250 cm^{-1}. but causes considerable shift of two other characteristic lines. If an *iso*-propyl group is attached to the ring the spectrum is entirely changed; the line at 1250 cm^{-1}. becomes very faint, and the doublet at 815–915cm^{-1}. is replaced by a triplet.
H. F. G.

1911. Polarisation of Light Scattering. Part II. S. Venkateswaran. *Phil. Mag.* 15. *pp.* 263–282, *Feb.*, 1933.—Polarisation measurements of the vibrational Raman lines in 27 liquids are reported, and the results are discussed in relation to the molecular structure of these compounds. A close dependence of the polarisation phenomenon on the geometrical structure of the molecule is observed. The lines characteristic of the oscillation of the benzene nucleus are polarised respectively more or less to the same extent in the derivatives. The components of the CH band assume a wide range of depolarisation values. Raman lines arising from transverse oscillations are invariably highly depolarised, all of them showing the limiting depolarisation value 6/7. From a consideration of the Raman spectrum of H_2O_2 it is shown that the two O atoms in the molecule are probably attached with a single bond, and that the compound should be represented by the formula HO—OH. [For Part I see Abstract 1074 (1933).]
AUTHOR.

1912. Fundamental Frequencies of the SiO_4 Group. J. Weiler. *Zeits. f. Physik*, 80. 9–10. *pp.* 617–628, *Feb.* 16, 1933.—The results of Raman analysis of compounds containing SiO_4 groups. Four frequencies are found, partially variable with degree of polymerisation, attributed to the SiO_4 group. These make possible the co-ordination of the infra-red spectrum of crystalline quartz.
W. V. M.

1913. Self-Registering Spectrometer. C. Leiss. *Phys. Zeits.* 34. *pp.* 172–175, *Feb.* 15, 1933.—Describes the coupling of the dispersion drum of a spectrometer or monochromator to a registering drum which is mechanically driven. Galvanometer deflections are recorded on photographic paper in the usual way.
F. S.

1914. Relation between the Resolving Power of a Spectroscope and the Principle of Uncertainty. S. Goldman. *J.O.S.A.* 23. *pp.* 70–71, *Feb.*, 1933.—A mathematical formulation of the relationship between resolving power and the uncertainty principle for both prism and grating spectrographs. A. H.

1915. Influence on the Accuracy of Measurements of Band Heads by Errors in Developing Spectrogram Photographs (Fringe Effect). H. Seeman. *Zeits. f. Physik*, 80. 7–8. *pp.* 506–513, *Feb.* 6, 1933.—The author extends earlier work and uses microphotometer methods to substantiate completely his previous results and theory. [See Abstract 1969 (1914).] W. R. A.

1916. Spectral Photometry in the Extreme Ultra-Violet. H. Arens. *Zeits. f. Physik*, 80. 9–10. *pp.* 629–635, *Feb.* 16, 1933.—The author is concerned with the preparation of photographic plates which shall be sensitive in the extreme ultra-violet (down to $0 \cdot 2\ \mu$). Photograms showing the sensitivity ranges of the different silver halides are given, and the small range of sensitivity of AgI at about $0 \cdot 42\ \mu$ is related to an absorption band at this wave-length. To obtain sensitivity in the desired range two methods are discussed: superposing a fluorescent substance on an ordinary emulsion, and using gelatin free coatings of the silver halides (Schumann plates). W. S. S.

See also Abstracts 1747, 1854, 1864, 1877, 1958, 1986, 1987, 2003, 2024.

VISION.

1917. Sensibility to Colour Temperature Change as a Function of Temperature. D. B. Judd. *J.O.S.A.* 23. *pp.* 1–14, *Jan.*, 1933.—Experimental measurements were made of the smallest difference in temperature of an incandescent lamp which could be detected as a change in colour of the emitted light. This threshold difference $\Delta\,\theta$ was determined for temperatures θ of 1800°, 2200°, 2900°, 5000° and 11,000° K, the latter two temperatures being obtained by combining a colour filter with the lamp. It was found that $\Delta\,\theta/\theta^2$ was practically constant over the range studied. Priest's empirical relation that $\Delta\,\theta$ should correspond to a constant difference in the spectral centroid of light was also confirmed. Judd's empirical relation that $\Delta\,\theta$ should correspond to a constant difference in the "red" trilinear co-ordinate gave discrepancies which exceeded the experimental uncertainty. The results have a bearing on the question of "colour constancy." W. S. S.

1918. Chromaticity Sensibility to Wave-Length Difference as a Function of Purity. E. P. T. Tyndall. *J.O.S.A.* 23. *pp.* 15–24, *Jan.*, 1933.—Measurements were made of the least perceptible difference of wave-length between two halves of a photometric field adjusted to have equal brightness, (*a*) when the stimulation in each half-field was monochromatic, (*b*) when in addition to the monochromatic radiations whose threshold difference of wave-length was determined, the two halves of the field contained a heterogeneous stimulation such as daylight. In this way the sensibility to wave-length difference was obtained for different purities, ranging from unity to a few per cent. A continuous decrease of sensibility with decrease of purity was observed for wave-lengths 635, 580, 530 and 493 $m\mu$, but for $\lambda = 455$ and neighbouring wave-lengths the sensibility first decreased then increased to a maximum at a purity of about 15 per cent, and finally decreased rapidly. The form of the curve for $\lambda = 455$ was shown to depend on the spectral distribution of the heterogeneous stimulus. Two hypotheses are discussed to explain the peculiar results at low wave-lengths. For all the measurements the retinal illumination was of the order of 120 photons. W. S. S.

1919. Dependence of Visual Acuity upon Stimulus-Distance. M. Luckiesh and F. K. Moss. *J.O.S.A.* 23. *pp.* 25–29, *Jan.*, 1933.—Measurements of visual acuity were made with the test object distant 60, 120 and 280 cm. from the eyes and at brightness levels of 1 and 10 millilamberts, for ten subjects. An increase in visual acuity with test object distance was observed, in conformity with the results of Freeman [see Abstract 1092 (1933)]. Binocular vision without artificial pupil was employed. Measurements were also made of the pupil diameters of the subjects when viewing the test object under different conditions. A weak correlation was observed between visual acuity and variations of pupil diameter for different distances of the test object. W. S. S.

1920. Accommodative Effort of Corrected Ametropes. E. Haas. *Comptes Rendus*, 196. *pp.* 645–646, *Feb.* 27, 1933.—It is shown that when spectacles are used to correct an ametrope for infinity, the accommodative effort for objects at finite distances is less (myope) or greater (hypermetrope) than for an emmetrope. The differences in accommodative effort may be of the order of half a diopter. The bearing of these facts on the design of corrective lenses is discussed. W. S. S.

X-RAYS.

1921. X-Ray Scattering Power of Metallic Silver for Copper Kα Radiation. L. Chrobak. *Zeits. f. Krist.* 84. *pp.* 475–477, *Feb.*, 1933. *In English.*—The F curve of silver is measured for Cu Kα radiation. Powdered silver is used and the measurements are made with an ionisation spectrometer. The experimental relative intensities are compared with the intensity of the NaCl (220) reflection. J. T.

1922. Atomic Scattering Factor for X-Rays in the Region of Anomalous Dispersion. D. Coster and K. S. Knol. *Roy. Soc., Proc.* 139. *pp.* 459–466, *Feb.* 1, 1933.—A method is described of calculating theoretically the atomic factor for X-rays in the region of anomalous dispersion, especially in the neighbourhood of the K-edge of the scattering element. It is shown that not only the absolute value of the atomic factor, but also its argument, *i.e.*, the phase difference between the primary and the scattered beam, which is a function of λ and of $\sin\theta$, has to be taken into account. This phase difference assumes rather large values on the short wave-length side in the neighbourhood of the K-edge of the scattering element. H. H. Ho.

1923. Wave-Lengths of the Kα_1-Lines of Various Elements. J. A. Bearden. *Phys. Rev.* 43. *pp.* 92–97, *Jan.* 15, 1933.—The author has used the double-crystal X-ray spectrometer to remeasure several important lines. The wave-lengths of the Kα_1 lines of silver, molybdenum, copper, iron and chromium have been determined, and are compared with previous precision determinations. The values for the silver and molybdenum lines agree well with photographic methods, whilst copper, iron and chromium show considerable divergences. It is pointed out that for the two former elements the lines are symmetrical, whilst they are asymmetrical for the others. It is concluded that the double-crystal spectrometer has decided advantages when used upon asymmetrical lines. J. E. R. C.

1924. M-Series of Tantalum Obtained by Means of an Ionic Tube. V. Dolejšek and (Miss) E. Filčáková. *Comptes Rendus*, 196. *pp*. 388–389, *Feb*. 6, 1933.—By means of an improved form of Dolejšek's ionic tube [see Abstract 2855 (1932)] working at 3400 volts, the tantalum lines $M_{I}N_{III}$ 5385, $M_{III}O_{I}$ 5820, and $M_{IV}N_{III}$ 8875X, corresponding to the lines of tungsten found by Lindberg [see Abstract 185 (1929)], and also the lines $M_{V}O_{III}$, 7280 for Ta and 6990 X for W, have been measured. C. A. S.

1925. X-Ray Satellites. H. C. Wolfe. *Phys. Rev.* 43. *pp*. 221–223, *Feb*. 15, 1933.—Druyvesteyn's explanation of the Kα satellites has been put to the test of numerical calculation using the Hartree field in the case of potassium (Z = 19). The Kα satellites are attributed to transitions from states with one K and one L electron missing to states with two L electrons missing. Treating e^2/r_{12} as a perturbation and using the wave functions of the unperturbed Hartree wave equation, the energies belonging to the configurations $1s\,2s$, $1s\,2p$, $2s\,2p$, and $(2_p)^2$ were calculated according to Slater's theory of complex spectra. The symbols describing the configurations refer to electrons missing from closed shells. The assumption of Russell-Saunders coupling is a justifiable approximation, since the interchange energies turn out to be large compared with the spin-orbit interaction, which is measured by the K$\alpha_{1,2}$ doublet separation. E. E. F. d'A.

1926. Weak Lines of the K-Spectra of 42 Mo and 47 Ag. E. Carlsson. *Zeits. f. Physik*, 80. 9–10. *pp*. 604–609, *Feb*. 16, 1933.—Cauchois' method applied to bring out lines K β_4 and K β_5. The K β_1 line is in analogy with the K β_5, and is opposed to the DuMond-Hoyt hypothesis as to conduction-electron effect, and has to be regarded as a "prohibited" transition. A. D.

1927. Corpuscular X-Ray Spectra of the Radio-Elements. C. D. Ellis. *Roy. Soc., Proc.* 139. *pp*. 336–342, *Feb*. 1, 1933.—By direct comparison of the β-ray spectra of radium (B + C) and thorium (B + C) it is found that certain lines are common to both. These must represent the corpuscular X-ray spectrum of an atom of atomic number 83, since the electronic structure of an atom of this atomic number is the only common feature in the two sources. The energies of these lines agree well with this hypothesis, and interesting data concerning the intensities of these double electronic transitions is obtained. A. H.

1928. Spectral Composition of X-Radiation from Filtration Curve. L. Silberstein. *Phil. Mag.* 15. *pp*. 375–394, *Feb*., 1933. *Supplement*.—Formulæ are derived for calculating the intensity of X-rays of a given wave-length present in an X-ray beam, from the intensity of this beam when filtered by different thicknesses of metal foil. Filtration curves obtained for Metalix and Media tubes operated at various voltages are used, and the corresponding radiations are analysed. J. T.

1929. Emission and Absorption Spectra with Bent Crystals as Transmission Gratings. A. Sandström and E. Carlsson. *Zeits. f. Physik*, 80. 9–10. *pp*. 597–603, *Feb*. 16, 1933.—Johann [see Abstract 3118 (1931)] and Cauchois [see Abstract 4059 (1932)] have developed methods of using bent gypsum crystals for producing a focussing effect in X-ray spectroscopic work. The present paper gives an experimental examination of these methods, with details and photographs. A. D.

See also Abstracts 1671, 1695, 1877, 1915, 2003, 2046, 2053, 2076, 2084.

HEAT.

CALORIMETRY.

1930. Heat Capacity and Free Energy of Formation of Ethylene. M. E. Haas. *Univ. Pittsburgh Bull.* 29. *pp.* 116–120, *Jan.* 10, 1933.—The specific heat of ethylene has been redetermined from 0° to 68° C. [See also Abstract 5344 (1932).] A. S. C. L.

1931. Electrical Differential Method for the Measurement of C_v in Gases. Part V. M. Trautz and H. Blum. *Ann. d. Physik,* 16. 3. *pp.* 362–376, *Feb.,* 1933.—The differential method developed by Trautz is further considered, and various errors are discussed and evaluated. The specific heat of carbon dioxide at the temperatures 15°·3, 18°·0 and 19°·0 C. is found to be 6·77, 6·79 and 6·80 cal. per mole per 1° C. taking as standard the value 4·957 for air at 20° C. J. H. A.

See also Abstracts 1701, 1739, 1941, 1962, 2017.

CONDUCTION.

1932. Heat Transfer for Fluids Flowing in Tubes. E. Hofmann. *Phys. Zeits.* 34. *pp.* 208–211, *March* 1, 1933.—Discusses the various experimental determinations of the heat flow from fluid to tube wall when a gas or liquid flows turbulently in a tube. The results are expressed in terms of the usual dimensionless variables, and the discrepancies between the equations of various authors are discussed. J. H. A.

1933. General Properties of Steady Temperatures in Solids Partially Exposed to Gas. R. V. Churchill. *Physics,* 4. *pp.* 50–55, *Feb.,* 1933.—Five general properties of steady temperatures in solids of arbitrary shape are derived. The solid has any portion of its surface held at a fixed temperature distribution and the rest exposed to gas. The rate of transfer of heat between gas and surface is assumed to be any function of the position of the point and the temperature of the surface, for a given state of the gas. For a fixed temperature this function is called the emissivity. Briefly stated, the important properties are: (1) In two geometrically similar solids exposed to the same surface temperature conditions at corresponding points, except that their emissivities are inversely proportional to their sizes, the temperatures at corresponding points are equal. (2) If the entire surfaces of two geometrically similar solids are given fixed temperature distributions the temperatures at corresponding points are equal everywhere if they are equal on the surfaces. (3) An increase in the size of a solid causes the same temperature change as an increase in its emissivity. (4) An increase in the size of a solid causes an increase in the temperature at each point if the solid is receiving heat from the gas, and a decrease if the solid is losing heat to the gas. (5) From Newton's law of surface heat transfer there follows a linear relation between the steady temperature at any point and the uniform temperatures of the gas and the fixed-temperature surface. These properties are discussed at the end of the paper. Some of the results of (4) seem contrary to expected results. AUTHOR.

1934. Geometry of the Heat Equation. Part II. E. Kasner. *Nat. Acad. Sci., Proc.* 19. *pp.* 257–262, *Feb.,* 1933.—Amplifying previous work [for Part I see Abstract 4398 (1932)] a full discussion from the point of view of differential geometry is pursued, of the family of curves represented by $\nu = \phi$ (x, y, t). In this equation ν is the temperature, x, y, t are co-ordinates of position and time, and the function ϕ satisfies Fourier's equation for heat conduction. This family contains in general a doubly infinite set of curves, degenerating in certain circumstances to a singly infinite set. As the chief result of the investigation, it is proved that three distinct types of degeneration occur, connected with the equations of Laplace, Poisson and Helmholtz. J. P. A.

1935. Thermal Conductivity of Air. H. S. Gregory and C. T. Archer. *Phil. Mag.* 15. *pp.* 301–309, *Feb.*, 1933.—A reply is given to the criticism by Hercus and Laby of the authors' earlier work on the thermal conductivity of air, and it is claimed that the hot-wire method is more accurate than the plate method. The authors' original results have been re-examined and the thermal conductivity of air is found to be 585×10^{-7} at 0° C. G. G. S.

CONVECTION.

1936. Heat Transfer by Natural Convection. R. Hermann. *Phys. Zeits.* 34. *pp.* 211–212, *March* 1, 1933.—The heat loss from a horizontal cylinder in still air is studied. A theoretical solution is obtained using the boundary layer theory, and is found to be in excellent agreement with the experiments of Schmidt in which the temperature distribution around the cylinder was carefully measured. [See also Abstract 4401 (1932).] J. H. A.

See also Abstracts 1932, 1933.

DILATATION.

1937. Linear, Thermal Expansion of a Single Crystal of Sodium Nitrate. J. B. Austin and R. H. H. Pierce, Jr. *Am. Chem. Soc., J.* 55. *pp.* 661–668, *Feb.*, 1933.—By means of linear expansion measurements in different directions it is shown that the gradual transition occurring between 150° and 278° is most marked in the direction of the C axis and not detectable along the *a*-axis. This is interpreted as indicating a separation of the layers of nitrate ions resulting from the change in the eigenfunctions caused by the rotation of the ion. The angle α is calculated to be 45° 34′ at 280° as compared with α = 45° 35′ obtained from the X-ray data by Kracek, Posnjak and Hendricks. H. H. Ho.

See also Abstract 1708.

EVAPORATION.

1938. Process of the Production of Vapour. K. Schreber. *Zeits. f. techn. Physik,* 14. 2. *pp.* 81–85, 1933.—This paper is a critical discussion of the question of the existence of a temperature difference between a liquid and its vapour when the liquid is being evaporated. Faraday had, in 1822, observed such a difference, but this observation was neglected by Gay-Lussac and his followers. As it is well known from Thomson's equation that the vapour pressure of a liquid depends on the curvature of the surface of the liquid, it is advisable in considering the process of evaporation to prevent the formation of bubbles. Heidrich's experiments on evaporation without bubble formation are discussed and defects in the experimental details pointed out. The experiments, however, prove the existence of the temperature difference. The investigations

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carried out at the Reichsanstalt by Jakob and Fritz in 1930 and 1931 are then reviewed. Bubble formation took place in these investigations, whereby complications are introduced. In pure liquids the temperature difference between a liquid and its vapour depends on the velocity of evaporation. In the case of solutions and curved surfaces it further depends on osmotic pressure and the curvature. T. B.

1939. Effect of High Electrostatic Fields upon the Vaporisation of Molybdenum. G. B. Estabrook. *Univ. Pittsburgh, Bull.* 29. *pp.* 65–77, *Jan.* 10, 1933.—The filament of a tungsten lamp operated at its normal temperature of 2450°K. is known to decrease in cross-sectional area with time, depositing metal upon the glass of the lamp and creating an increase in the resistance of the wire. The present work investigates the effects of high electrostatic radial fields on small heated molybdenum wires and records that (*a*) for field-strengths of about $0 \cdot 52 \times 10^6$ volt/cm. or less at the wire surface there is no change in the rate of resistance with time, *i.e.*, with the rate of evaporation upon application of the field; (*b*) for field-strengths above this value as successively higher fields are applied the rate of vaporisation decreases slowly at first, then more rapidly, and finally asymptotically towards zero at field-strengths over $1 \cdot 8 \times 10^6$ volts/cm. Keeping the field-strength constant, increase of temperature produces successively smaller decreases in the rate of vaporisation, and it was noted that when any effect upon the rate of vaporisation occurred application or removal of the field produced sudden increases and decreases in the electrical resistance respectively. For platinum and molybdenum the sudden increases and decrements were in the opposite direction to that of tungsten. S. G. B.

MELTING AND BOILING POINTS.

1940. Purification and Physical Properties of Organic Compounds. Part I. Heating and Cooling Curves. E. L. Skau. *Am. Acad., Proc.* 67. *pp.* 551–576, *Jan.*, 1933.—Describes apparatus for taking cooling curves under standardised conditions and with a considerable degree of supercooling. The characteristics of the heating or cooling curve may then be used as criteria of the purity of the sample, independently of any knowledge of the "true" freezing point. J. H. A.

1941. Cryoscopic Studies on the Transition Points of Compounds of Organic Compounds with Salts. H. Oosaka. *Tokyo B.D., Science Reports, No.* 22. *pp.* 241–249, *Jan.* 30, 1933. *In English.*—The lowering of the transition point (melting point to anhydrous salt) of $NaI \cdot 3CH_3OH$ by other substances has been measured. The molecular heat of fusion of the alcoholate, calculated from the cryoscopic constant, is 7276 cal. A. S. C. L.

1942. Cryoscopy of Paraldehyde, Acetone and Ether in Solutions of Ammonium and Magnesium Sulphates. F. Bourión and (Miss) O. Hun. *Comptes Rendus,* 196. *pp.* 480–482, *Feb.* 13, 1933.—In magnesium and ammonium sulphate solutions paraldehyde does not give a cryoscopic constant, the value increasing with dilution owing to increasing depolymerisation. Ether and acetone give constants. A. S. C. L.

1943. Cryoscopic Rules and Dipole Theory. W. Fischer. *Zeits. f. phys. Chem.* 163. *Abt.A.* 3–4. *pp.* 257–262, *Feb.*, 1933.—The molecular association of liquids, as measured by cryoscopic methods, has shown certain regularities summarised by v. Auwers. These are discussed in the light of the modern theory of dipoles. J. H. A.

1944. Freezing Points of Binary Mixtures of Ethyl Alcohol and Ethyl Ether. A. Lalande. *Comptes Rendus*, 196. *pp.* 402–404, *Feb.* 6, 1933.—The freezing point-composition curve gives no indication of the formation of a compound. The eutectic temperature is −125° C, and the eutectic mixture contains 57·85 % by weight of ethyl alcohol.
H. F. G.

1945. Errors in Binary Freezing-Point Diagrams. E. L. Skau and B. Saxton. *J. Phys. Chem.* 37. *pp.* 183–196, *Feb.*, 1933.—Freezing points as usually observed need correction for the amount of solid which has crystallised out before the freezing point is taken. Errors become more serious as the eutectic is approached. The result of correction is shown for the system : β-chlorocrotonic acid/β-chloro*iso*crotonic acid.
A. S. C. L.

1946. Freezing Point/Solubility Relations of Geometrical Isomers. Part II. E. L. Skau and B. Saxton. *J. Phys. Chem.* 37. *pp.* 197–207, *Feb.*, 1933.—*Cis-trans* dynamic isomerism of anisaldoxime has been followed by heating and cooling curves. The equilibrium mixture contains 12·3 % of the *cis* form, and its freezing point is 58·4°C. [For Part I see Abstract 876 (1929).] A. S. C. L.

1947. Helium Liquefaction Plant at the Clarendon Laboratory, Oxford. F. A. Lindemann and T. C. Keeley. *Nature*, 131. *pp.* 191–192, *Feb.* 11, 1933.—An inexpensive type of apparatus is described by which helium may be liquefied. The helium is compressed at 100 atmospheres in the lower part of the space between two concentric cylinders. Hydrogen is liquefied in the upper part and collects above the space containing helium. By evaporation of the hydrogen and expansion of the helium, half of the latter is liquefied, while if the space above the helium is evacuated the temperature falls to 1°–2° Abs. The substance under test is contained inside the inner cylinder while the two cylinders are placed in a Dewar flask containing liquid hydrogen. The process can be repeated as desired in a few minutes at very small cost of liquid hydrogen, and very little helium is lost. R. S. R.

See also Abstract 1761.

TEMPERATURE, MEASUREMENT OF.

1948. Temperature and the Principle of Similitude. A. Busemann. *Zeits. f. techn. Physik*, 14. 3. *pp.* 131–135, 1933.—The principles of the argument from dimensions are discussed, magnitudes being classified according to the number of characteristics which can be arbitrarily chosen. Thus electrons are in the zero class, since they are simply enumerated ; mass, force and density are all in the first class since a specification of the unit determines their measure. Quantities like time or heat-content require not only a unit but also a zero point, and are in the second class. The author considers that before the discovery of the second and third laws of thermodynamics, temperature was in class ∞, since the only relation was that of greater or less ; it was in fact a quality and not a quantity. This remains true in certain problems. Only the *absolute* temperature can have dimensions and this only enters into problems when the second and third laws of thermodynamics are explicitly or implicitly involved. J. H. A.

1949. Passage of Mercury through Narrow Capillaries. H. Ebert and W. Ende. *Zeits. f. techn. Physik*, 14. 2. *pp.* 64–67, 1933.—The movement of mercury through narrow capillaries is studied by kinematograph pictures. The photographs show that the movement is intermittent. Occasionally there occur comparatively long intervals during which no movement of the mercury takes place. This phenomenon is probably connected with the presence of impurities in the mercury. [See also Abstract 199 (1931).] G. G. S.

1950. Method of Producing the Thermoelectric Effect. A. Égal. *Comptes Rendus*, 196. *pp.* 332–334, *Jan.* 30, 1933.—A thermopile may be constructed very simply by forming a helix of resistance wire (*e.g.*, constantan) and soldering a length of iron wire, of comparatively low resistance, diametrically across each turn ; although each couple is short-circuited by the constantan wire, if this is of sufficiently low resistance, compared with the iron, the loss is not considerable. Alternatively, a film of iron may be deposited at equidistant intervals along the resistance wire, the alternate sections remaining uncovered, and the wire may then be formed into a helix of such diameter that all the " junctions " lie along one side. Both these methods of construction have the advantage that if one or more of the junctions become damaged the thermopile continues to function. H. F. G.

1951. Measurement of the Temperature of a Coal-Gas Flame by "α-Particle Method." A. Shirodkar. *Phil. Mag.* 15. *pp.* 426–440, *Feb.*, 1933.—It is well known that the range of α-particles varies directly as the absolute temperature of the absorbing gas. A flame of known thickness being introduced in the path of α-particles in air, their range changes because (1) of the difference in the stopping power of the gas in the flame and that of air, and (2) of the temperature of the flame. Knowing, or determining experimentally, the stopping power of the gas, the change due to (1) is calculated, and thus the change due to (2) is known. By making use of the simple relation that the range varies directly as the absolute temperature of the absorbing gas, the flame temperature can be calculated. In the case of a coal-gas flame the temperature was found to be 1845° C. with an error of about + 100° C. T. B.

See also Abstracts 1867, 1947, 1953.

THERMOCHEMISTRY.

1952. Temperature Coefficient of the Recombination Rate of Atomic Hydrogen. I. Amdur. *Univ. Pittsburgh, Bull.* 29. *pp.* 7–14, *Jan.* 10, 1933.—Recombination of atomic hydrogen is a third order reaction in the gaseous phase with a negative temperature coefficient. A. S. C. L.

1953. Flame Temperatures of Complex Mixtures of Gases and a Method for Calculating Them. B. Lewis, H. Seaman and G. W. Jones. *Frank. Inst., J.* 215. *pp.* 149–167, *Feb.*, 1933.—The flame temperatures of mixtures of hydrogen, or methane, or carbon monoxide containing various amounts of nitrogen and carbon dioxide, with air, have been determined. The flame temperatures of a number of complex mixtures of combustible gases and industrial gases have also been determined. A method of calculating the maximum flame temperature of any mixed gas is described. Good agreement is found between the calculated and determined temperatures of the gases used in this investigation. AUTHORS.

1954. Ignition of Explosive Gaseous Mixtures by Small Flames. J. M. Holm. *Phil. Mag.* 15. *pp.* 329–359, *Feb.*, 1933. *Supplement.* The previous theory of the failure of the flames of explosive gaseous mixtures to travel along narrow tubes [see Abstract **4665** (1932)] is developed, and a definite connection established between the limiting diameter for flame propagation at constant pressure and the limiting pressure for flame propagation in a tube of fixed diameter. The experimental section of the paper deals with the measurement of the variation of the velocity of flame propagation with tube diameter for diameters near the limiting value, the limiting values for hydrogen-air and ethyl ether-air mixtures, the effect of inert diluents on the limiting diameters, and the extinction of a rapidly moving flame by partitions arranged across the tube. The results confirm the hypothesis that the extinction is due to the cooling effect of unburnt gas in contact with the external flame surface, the limiting diameters being controlled by the thermal properties of the gaseous mixture. J. S. G. T.

1955. Experiment on the Combustion of an Inflammable Gas Mixture by a Hot Wire. J. D. Morgan. *Phil. Mag.* 15. *pp.* 440–442, *Feb.*, 1933. *Supplement.*—It has been suggested by J. J. Thomson that electrons possibly prepare the way for an explosion by ionising the gas. The writer also noticed that the temperature at which a hot wire will cause an inflammation of a combustible gas mixture is about that at which it will discharge an electroscope. A small explosion chamber contains a short helix of platinum wire forming part of an electric circuit the current in which can be varied. An insulated metal piece situated close to the wire in the chamber is connected to a charged electroscope outside the chamber. The experiments prove that ionisation does not appear in the gas until flame appears, and that ionisation of the gas is a consequence, and not a cause of inflammation. The combustion which occurs in the gas mixture is due to the heat given off by the wire. T. B.

1956. Recording of Pressure and Time in Gas Explosions. B. Lewis and G. v. Elbe. *Am. Chem. Soc., J.* 55. *pp.* 504–507, *Feb.*, 1933.—A diaphragm indicator for measuring the pressures developed in explosions is described. Its essential advantages are sensitivity, freedom from hysteresis for the deflections employed, and constancy. A method of calibrating dynamically, without removing the diaphragm from the explosion chamber, is described in which pressures are released against the diaphragm in a time interval of the same order as in explosions. The observed deflections for a given range of pressures investigated are shown to be the same for dynamic as for static calibration. N. M. B.

1957. Application of Quantum Mechanics to Chemical Kinetics. R. P. Bell. *Roy. Soc., Proc.* 139. *pp.* 466–474, *Feb.* 1, 1933.—The majority of modern treatments of the mechanism of chemical reactions treat the transit involved as obeying the laws of classical mechanics. Previous statements that a quantum-mechanical treatment is unnecessary are based on approximations of doubtful validity. The present paper gives a strict mathematical treatment of a simple system which is typical of the transits involved in chemical reactions. It is concluded that a quantum-mechanical treatment is necessary for any reaction involving the motion of a hydrogen atom or proton, while heavier atoms may be considered to behave classically. It is shown that the departure from classical behaviour will in some cases lead to discrepancies between the experimental data and current theories of reaction kinetics. The data at present available, do not permit of a strict test of these considerations, though several instances are quoted which appear to support the conclusions above. H. H. Ho.

1958. Quantum Mechanics and Chemistry with Particular Reference to Reactions Involving Conjugate Double Bonds. H. Eyring. *Science,* 77. *pp.* 158–160, *Feb.* 10, 1933.—Because of the much greater mass of atoms than electrons, the former travel relatively much more slowly, so that in calculating the potential energy of any system from the Schrödinger equation, and neglecting atomic motions, an expression is obtained in which the potential energy is a function of the distance between the atoms. Application of this result is now shown to provide the necessary information for estimating rates of reactions and activation energies. The reaction $H_2 + I_2 = 2HI$ is first considered, from which it is shown that the calculation of the activation energies of the different mechanisms will indicate the way in which a reaction will proceed. The evaluation of the coulombic and interchange binding between atomic pairs as a function of the distance between the atoms is shown to be accomplished by reference to curves constructed from spectroscopic constants, and empirical Morse curves are at present found to be the most convenient for this purpose. The conversion of ortho to para hydrogen and a proposed mechanism for the hydrogen chlorine reaction are discussed from the above standpoint. H. H. Ho.

See also Abstracts 1880, 1887, 1898, 1904, 1951, 1959, 1961, 1964, 1976.

THERMODYNAMICS.

1959. Thermodynamics of Mixtures with Application to Ethyl-Alcohol. V. Fischer. *Helv. Phys. Acta,* 6. 1. *pp.* 42–67, 1933. *In German.*—A general differential equation is derived which satisfies the equations of state of a mixture of *n*-components, and a general solution is given, which is applied to eythl-alcohol-water mixtures. The heats of admixture and specific heats are calculated, and compared with the experimental data of Bose. The equilibrium isotherms and isobars are constructed and compared with the experimental values of Bergström and Grumbt. It is shown that the apparently great differences between the various curves follow from simple geometrical relationships which correspond to the experimental results. The assumption by Bose of complex chemical processes in mixtures of ethyl alcohol and water appears to be invalid, and a purely physical process seems probable. H. H. Ho.

1960. Heat Diagram for Benzene, C_6H_6. H. Mehlig. *Zeits. f. techn. Physik,* 14. 2. *pp.* 86–89, 1933.—This paper gives the data and equations necessary for drawing the temperature-entropy diagram for benzene. Young's data for the saturation vapour pressures and specific volumes are employed for the range 70° to 288·5° C, the critical temperature; and for the range 0° to 130° C, the values obtained by Fiock, Ginnings and Holton [see Abstract 3145 (1931)] are used. The equation of state employed is the simple one $v = C_1T/P - C_2 = 10{\cdot}63\,T/P - 0{\cdot}0064$ ($m^3/kg.$). The diagrams are given in the paper. T. B.

1961. Thermal Equilibrium between Oxygen Molecules and Atoms. G. v. Elbe and B. Lewis. *Am. Chem. Soc., J.* 55. *pp.* 507–511, *Feb.,* 1933.—A rigorous equation is deduced for the equilibrium constant of the reaction $2O \rightleftarrows O_2$ with the aid of optical data and new determinations of the specific heat of oxygen at high temperatures [see following Abstract]. The equation is believed to be valid up to 4000° Abs., and a table is given for log K_p and the degree of dissociation up to 5000° Abs. Proof of the correctness of the latter is given by experiments on the specific heat of oxygen. N. M. B.

1962. Specific Heat of Oxygen at High Temperatures from Ozone Explosions and the Energy of the $^1\Delta$ Level of the Neutral Oxygen Molecule. B. Lewis and G. v. Elbe. *Am. Chem. Soc., J.* 55. *pp.* 511–519, *Feb.*, 1933.—The mean specific heat of oxygen between 300° Abs. and 1400° to 2500° Abs. has been determined by exploding ozone-oxygen mixtures in a constant volume bomb. The values after correcting for dissociation are higher than the theoretical values calculated from the known vibrational-rotational levels of the oxygen molecule by an amount which allows the calculation of the energy of the hitherto unknown but predicted $^1\Delta$ metastable level of the neutral oxygen molecule; this is found to be $0{\cdot}75 \pm 0{\cdot}05$ volt or $17{,}200 \pm 1000$ calories above the ground state of the molecule. The new mean specific heat curve, which includes the contribution from the $^1\Delta$ level, fits the experimental values very well along the whole range of temperature investigated. Results also provide a fair proof for the dissociation equation [see preceding Abstract]. A table of true specific heats, C_p, is given for the range 200°–3000° Abs. Two empirical formulæ are given to represent this curve in two different ranges of temperature. N. M. B.

1963. Solid Carbon Dioxide from Flue Gas. F. E. E. Germann. *Indust. and Engin. Chem.* 25. *pp.* 150–152, *Feb.*, 1933.—The limitations of sources of supply of carbon dioxide are noted. A curve is given showing the relation between vapour pressure and temperature of solid carbon dioxide in equilibrium with a mixture of 10 % carbon dioxide and 90 % nitrogen. A new method of producing solid carbon dioxide from gas mixtures containing 10 % or less of carbon dioxide is described. The method makes use of the Joule-Thomson cooling of the imperfect gas mixture on expansion from several thousand pounds pressure. G. G. S.

1964. Value of the Determination of Free Energy Change for Organic Reactions. D. B. Keyes. *Science*, 77. *pp.* 202–204, *Feb.* 24, 1933.—It is pointed out that the most practical methods for the determination of free energy changes are based on the use of the entropy equation, $\Delta F^\circ = \Delta H - T\Delta S$, since the specific heats, latent heats, temperatures and heat changes during the reactions, can usually be measured with more accuracy than other physical constants. The present paper contains preliminary results obtained by work of this character on the reactions: (*a*) Ethylene and water to produce ethyl alcohol, for which purpose aluminium oxide impregnated with about 3 % of phosphoric acid was found to be the best catalyst, and $\Delta F^\circ_{700^\circ K} = +3500$ cal.; (*b*) propylene and hydrogen sulphide to produce an alkyl acid sulphide, where $\Delta F^\circ_{573^\circ K} = +3000$ cal., a value which is provisional, since considerable polymerisation of the propylene occurs in the presence of catalysts such as phosphoric acid on an activated charcoal. H. H. Ho.

1965. Free Energy of Formation of Iodine Monobromide in Carbon Tetrachloride Solution. D. M. Yost, T. F. Anderson and F. Skoog. *Am. Chem. Soc., J.* 55. *pp.* 552–555, *Feb.*, 1933.—Vapour

pressures of iodine monobromide in carbon tetrachloride solution have been measured by a flow method. The dissociation is 9·5 %. The free energy change for the reaction $\frac{1}{2}I_2 + \frac{1}{2}Br_2 = IBr$ is –221 cal. at 25° C.
A. S. C. L.

1966. Thermodynamic Properties of the H^1H^2, H^2H^2 Molecules and Compounds Containing the H^2 Atom. H. C. Urey and D. Rittenberg. *J. Chem. Phys.* 1. *pp.* 137–143, *Feb.*, 1933.—The summations of state and free energies of the molecules $H_2{}^1$, $H_2{}^2$ and H^1H^2 have been calculated at temperatures from 20·4 to 700°K and their dependence on the spin and statistics of H^2 discussed and illustrated. The equilibrium constants of the reaction $2H_2{}^1 + 2\,H_2{}^2 = 2\,H^1H^2$ are found to deviate markedly from the value 4 expected from simple probability considerations. The equilibrium constants of the reactions $H_2{}^1 + 2\,H^2Cl \rightleftarrows H_2{}^2 + 2\,H^1Cl$ and $H_2{}^1 + 2\,H^2I \rightarrow H_2{}^2 + 2\,H^1I$ have been calculated and found to be appreciably different from unity, showing that appreciable differences in equilibrium constants of chemical reactions may be expected depending on which isotope of hydrogen enters into the reaction. Small differences in the electrode potentials of the two hydrogen isotopes may be expected, but no exact estimates have been made.
AUTHORS.

1967. Thermodynamics of Irreversible Processes. Parts I and II. M. Sugita. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 579–591, *Nov., and pp.* 636–648, *Dec.*, 1932. *In German.*—This is a mathematical discussion divided into two parts. The author explains the difficulties in attempting to apply thermodynamical principles to irreversible processes and then suggests a method of overcoming them. The discussion is limited to stationary states, and an attempt is made to give a thermodynamical conception to heat conduction. In the second part the author has applied his generalised thermodynamics to homogeneous and heterogeneous effects and to the Thomson effect. The Wiedemann-Franz relation is deduced thermodynamically, and an attempt is made to establish Eastman and Wagner's idea of " Überführungswärme " thermodynamically. Finally, a short discussion is entered into on the contradiction between thermodynamics and statistics in the case of irreversible phenomena. T. B.

See also Abstracts 1700, 1930.

VAPOUR PRESSURE.

1968. Method for Examination of Binary Liquid Mixtures. W. A. Wright. *J. Phys. Chem.* 37. *pp.* 233–243, *Feb.*, 1933.—The pressure-temperature-concentration surface for the system of mixtures of two liquids is known in very few cases indeed. It is shown that the logarithm of the vapour pressure of either component is a linear function of the reciprocal of the absolute temperature, so that to outline the system completely, it is only necessary to observe curves of temperature against concentration at two convenient pressures. J. H. A.

1969. Vapour Pressure of Crystalline Benzene and Cyclohexene. V. R. Deitz. *Am. Chem. Soc., J.* 55. *pp.* 472–475, *Feb.*, 1933.—The vapour pressures of crystalline benzene and cyclohexene have been measured by means of a modified Knudsen procedure. An analysis of the experimental errors entailed leads to a probable error in the vapour-pressure measurements of about 4 %. AUTHOR.

See also Abstract 1963.

ACOUSTICS.

1970. Distribution of Sound from Sources in the Neighbourhood of Plane Reflectors. F. A. Fischer. *E.N.T.* 10. *pp.* 19–24, *Jan.*, 1933.—When sound is emitted from a point source near a reflecting surface, the effect at a distance is that of an acoustical doublet composed of the source and its image. Polar diagrams are drawn to show the sound distribution for typical cases (*a*) when there is no phase change, and (*b*) when reversal of phase occurs at the reflecting surface. In case (*a*) a maximum of intensity always occurs in the plane of the reflector and other maxima and minima occur in directions inclined to this plane. In case (*b*) a minimum is always found in the plane of the reflector, and provided the source is not more than a quarter wave-length from the reflector, nowhere else. On increasing this distance other maxima and minima appear. If, instead of a single source, a series of equidistant sources on a normal to the surface is used, in case (*a*) the maximum in the plane of the reflector becomes relatively much greater; similarly the first maximum in (*b*), which is in a direction inclined to the surface, is more pronounced. Formulæ are given in each instance for the acoustical energy of the system; and the application of the results to signalling on land and below the surface of water is discussed. E. J. I.

1971. Sound Absorption in Multiatomic Gases. H. O. Kneser. *Ann. d. Physik*, 16. 3. *pp.* 337–349, *Feb.*, 1933.—The factors in classical mechanics responsible for sound absorption, namely friction and heat conduction, are insufficient to explain the facts, and a theory of absorption, based on the finite period of adjustment of thermal equilibrium [see Abstract 5124 (1932)], is shortly stated by means of which the experimental facts of absorption can be, to some extent quantitatively, explained. The agreement of the theoretical absorption with that measured by different investigators is tested in the cases of CO_2, N_2O, SO_2, O_2 and air. G. E. A.

1972. Theory of Dispersion of Sound. A. J. Rutgers and H. O. Kneser. *Ann. d. Physik*, 16. 3. *pp.* 350–361, *Feb.*, 1933.—A theory of dispersion of sound is developed on the same lines as Einstein's, but without the aid of further assumptions. The result as regards dependence on frequency is identical with that of Kneser and of Herzfeld and Rice, and is also in agreement with the experiments of Kneser and Pielemeier. Kneser's theory is criticised in that their reaction equations are not exactly the same, and Kneser replies in a following note. [See Abstracts 1114 (1921), 2157 (1928) and 1675 (1932).] G. E. A.

1973. Diagonal Symmetry in a Chladni Plate. R. C. Colwell. *Frank. Inst., J.* 215. *pp.* 169–177, *Feb.*, 1933.—The nodal lines on a square Chladni plate may be found approximately by assuming the plate to behave as a membrane with free edges parallel to the axes of x and y. The solution then depends on the equation—

$$A \cos\left(\frac{m\pi x}{a}\right)\cdot \cos\left(\frac{n\pi y}{a}\right) + B \cos\left(\frac{n\pi x}{a}\right)\cdot \cos\left(\frac{m\pi y}{a}\right) = 0.$$

If $A = B$ and $m = n \pm 1$, the diagonal is a nodal line. A number of examples are given in which this type of symmetry occurs in a plate excited by a valve oscillator. Positions of other nodal lines calculated by the approximate method are generally correct to 2 %. J. P. A.

1974. Vibrations of a Chladni Plate. R. C. Colwell. *Phil. Mag.* 15. *pp.* 317–324, *Feb.*, 1933.—Starting from the equation of motion of a square plate with free edges, the author shows that the general equation can represent the motion of a plate which vibrates like a membrane in the interior but not at the boundaries. This mode of vibration is studied in the case of a plate set in vibration by a valve oscillator, and a series of figures is reproduced and discussed. G. E. A.

1975. Sensitive Flames. J. Zahradníček. *Phys. Zeits.* 34. *p.*182, *Feb.* 15, 1933.—By using a number of small interchangeable nozzles of short conical shape, with diameters of opening from 2·5 to 1·5 mm., the author obtains a range of gas pressures from 1·9 to 5·7 cm. of water with a corresponding range in the upper limit of sensitiveness from 1·3 to 0·10 cm. for λ/4. [See also Abstract 2517 (1932).] G. E. A.

1976. Air Waves from Experimental Explosions. F. J. W. Whipple. *Nature,* 131. *pp.* 138–139, *Jan.* 28, 1933.—An account of observations received at Kew Observatory from various stations in the south of England relating to experimental explosions made at Oldebroek in Holland on Dec. 15, 1932. The aerial disturbance was appreciable over an area lying between the microphone stations at Hythe and Foulness and those at Nottingham, Birmingham, Cardiff and Bristol. The most satisfactory observations were made at Cambridge at times appropriate for normal transmission. Undograph records of the air waves were obtained in Germany to a distance of 225 km. on the line from Oldebroek to Lindenberg; an abnormal zone was also observed in Germany. No waves were recognised on the undograph records in Holland. G. E. A.

1977. Influence of Supersonic Waves on Chemical Processes. H. Beuthe. *Zeits. f. phys. Chem.* 163. *Abt.A.* 3–4. *pp.* 161–171, *Feb.*, 1933.—A number of chemical reactions have been investigated to ascertain if, and in what direction, they are influenced by a supersonic sound field [see Wood and Loomis, Abstract 3165 (1927), and Richards and Loomis, Abstract 990 (1928)]. It is found that, with all reactions produced by such sound waves, the gases dissolved in the liquid play a special part. If oxygen is present in the solution, hydrogen peroxide is first produced, and then causes all the observed reactions, such as the oxidation of potassium iodide, the reduction of potassium permanganate, etc. T. H. P.

1978. Calculation of the Average Coefficient of Sound Absorption. C. F. Eyring. *Acoustical Soc. of America, J.* 4. *pp.* 178–192, *Jan.*, 1933.—The author discusses the assumption upon which depend the formulæ of Millington [see Abstract 5129 (1932)] and Sette [see following Abstract]. It is pointed out that absorption coefficient measurements are normally used to calculate the reverberation period of auditoria and that, provided the same formula is used for calculating the reverberation period and the absorption coefficient, there will be very little difference between the results obtained from different formulæ. The decaying sound in a chamber consists of a combination of ordered and diffuse wave trains and it may happen that one of these decays at a different rate from the others. The author describes experiments in which this effect has been observed. It is noted that measurements upon an open window never give unity for the coefficient of absorption and this is ascribed to the lack of diffused state of sound energy produced by the window. Certain ordered states are not affected much by the window, however, and this leads to measured reverberation periods being too long. The question as to whether the geometric mean or the arithmetic mean of the absorptions should be taken is fully discussed and it is decided that a properly weighted arithmetic mean would be best. J. E. R. C.

1979. New Reverberation Period Formula. W. J. Sette. *Acoustical Soc. of America, J.* 4. *pp.* 193–210, *Jan.*, 1933.—Earlier reverberation formulæ have assumed that each surface receives a proportional share of the total energy at each reflection. In the formula presented in this paper it is assumed that any ray of sound, after repeated reflection, will have struck any one surface in proportion to the ratio of the area of that surface to the total room surface. The formula obtained is

$$T = -0\cdot05V/\Sigma_{x=1}^{x=k} S_x \log_e (1 - a_x),$$

where T = reverberation period, V = volume, S_x = area of absorbent having an average coefficient of sound absorption = a_x. The formula has the advantage that, when used to calculate a_x from measurements of the reverberation period of an experimental room, values greater than unity cannot be obtained. It breaks down if any one absorbing area has 100 % absorption since the initial assumptions are not then fulfilled. It is shown that, provided absorption coefficients obtained by the use of this formula are used then reverberation periods calculated from it do not differ appreciably from those calculated from the usual data and formula. The correct application of the formula and the effect of distributing an absorbent about a test chamber is discussed and it is deduced that measurements made upon a distributed specimen are more nearly characteristic of the results to be expected from the Sabine formula. The phenomenon of non-linear sound decay curves is also discussed. J. E. R. C.

1980. Loudness and the Minimum Perceptible Increment of Intensity. R. R. Riesz. *Acoustical Soc. of America, J.* 4. *pp.* 211–216, *Jan.*, 1933.—Equal loudness contours have been drawn by W. A. Munson by balancing tones of various frequencies against a note whose frequency was 1000 c.p.s., and whose intensity was a definite number of decibels above the auditory threshold. Taking one such contour as reference, the author proposes the hypothesis that two tones of different frequency will sound equally loud when their intensities are such that the ratios of the number of just perceptible steps above threshold, to the number of steps above threshold for the reference contour, are equal. From data previously recorded [see Abstract **2779** (1928)] this hypothesis is tested and found satisfactory except for very loud sounds. The implications of the principle are discussed. J. P. A.

1981. Use of Pressure Gradient Microphones for Acoustical Measurements. I. Wolff and F. Massa. *Acoustical Soc. of America, J.* 4. *pp.* 217–234, *Jan.*, 1933.—The operation of the pressure gradient microphone is compared with that of the pressure microphone. It is shown that the pressure gradient microphone may be used to measure particle velocity in a sound wave. The advantages of the pressure gradient microphone in making loud-speaker measurements, particularly outdoors, are pointed out and experimental data are given for some arrangements which were tried out. The characteristics of the distribution of particle velocity in a complex sound field are studied theoretically and experimentally with a ribbon microphone. A method is described for measuring the energy density in a sound field and some measurements which were taken in complex sound fields in rooms are discussed. It is shown that a combination of three pressure gradient or velocity microphones with a pressure microphone, placed adjacent to each other, may be equivalent in eliminating interference patterns to four pressure microphones placed at distances large compared to the wave-length and with random distribution. A microphone for measuring energy flow in a sound field is described. AUTHOR.

1982. Investigation of Acoustic Threshold Values. The Thermophone and its Use for Acoustic Measurements. W. Geffcken and L. Keibs. *Ann. d. Physik*, 16. 4. *pp.* 404–430, *Feb.*, 1933. —A theoretical investigation of Wente's theory of the thermophone is presented. It is found that the formulæ used to calculate the sound pressure in the chamber of the instrument lose their high accuracy as soon as the temperature of the conductor rises appreciably above the room temperature. Wente's theory is accordingly remodelled, the work being based on Langmuir's thermal equilibrium relations for electrically heated foil or wire. The calculations give for foil thermophones better results than are given by the earlier formulæ, but the discrepancies between theory and experiment are still too great to permit such instruments to be used for exact measurements. In the case of the wire thermophone, however, the formulæ obtained give results in very close agreement with experiment. The new formulæ were tested by sound pressure measurements with a double thermophone and by audibility threshold measurements with thermophones of different types. The wire thermophone was found to be very stable as regards calibration and in consequence quite suitable for exact measurements. [See also Abstract 3533 (1931).] A. W.

1983. Vibrations Produced in Bodies by Contact with Solid Carbon Dioxide. Mary D. Waller. *Phys. Soc., Proc.* 45. *pp.* 101–115; *Disc.*, 115–116, *Jan.* 1, 1933.—The paper describes the condition under which very loud notes may be produced and maintained for a considerable time in metal objects capable of vibration, such as tuning forks, bars, discs, rings, and tubes, when brought into contact with a solid carbon dioxide block. Notes have also been sustained in quartz crystals. It is shown that the vibration frequencies normally excited may range from about 1000 to 15000 ∼. Lower frequencies have been excited in wires. Surface-tension ripples may be produced on mercury. The vibrations are only produced by solid carbon dioxide of high density. The physical properties of the vibrating body which are of importance in connection with the phenomenon are considered. Evidence is brought forward in favour of the view that the source of energy for producing the vibrations is the heat which is given up by the metal to the solid carbon dioxide, and that the efficacy of this substance in producing vibrations is determined by the fact that it sublimes and in so doing produces considerable gas-pressures. Some suggestions regarding possible applications of the phenomenon are made. AUTHOR.

See also Abstract 1674.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstracts 2018, 2024.

CONDUCTION AND DISCHARGE IN GASES.

1984. Theories of Electrical Discharges in Gases at Normal Pressures and Temperatures. J. D. Stephenson. *Phil. Mag.* 15. *pp.* 241–262, *Feb.*, 1933.—An account is given of a number of theories which have been advanced by various experimenters to account for the discharge characteristics at normal temperatures and pressures. The author proposes a new theory based upon relations obtained from some experimental work, and shows that it is capable of yielding results closely in accordance with experimental measurements. It is noted that the breakdown voltage appears to be nearly independent of the ionisation potential of the gas, and it is suggested that ionisation at normal pressures involves a process different from that which occurs in low-pressure discharges. Discharges between spheres, between infinite electrodes, and in gaseous mixtures are considered. A table of breakdown voltages of a series of gases is given. [See also Abstract 1578 (1933).] J. E. R. C.

1985. Electrical Diffusion of Unipolar Ions in Gases. N. Wolodkewitsch. *Ann. d. Physik,* 16. 4. *pp.* 431–467, *Feb.*, 1933.—A theoretical investigation is first made of the distribution of field-strength and of charge density at points in a spherically symmetrical gas stream (streaming outwards from a central point) carrying ions of one sign and of one velocity. When a gas of any volume is occupied by ions of any velocity and the charge density of a single ion group has a homegeneous distribution, the total charge density is shown to be unaffected by electrical diffusion even when the velocity of single ions changes with time. If ions of different velocities are present the conception of " effective velocity " is introduced. A formula for the calculation of this effective velocity is derived. During the passage of a gas stream bearing unipolar ions down a tube, in contrast to the effects of gas kinetic diffusion, the relative loss due to electrical diffusion increases with increasing charge density, but is independent of the radius of the tube. A few methods for producing air streams carrying unipolar ions are investigated and an instrument, the " ionometer " is devised to measure the charge density. The effective velocities as deduced from the diffusion measurements are in good agreement with determinations using an electrostatic deflection method. F. C. C.

1986. Activation of Air by the Electrodeless Ring Discharge. B. Arakatsu and K. Kimura. *Faculty of Sci. and Agric., Taihoku Imp. Univ.* 5. *pp.* 143–157, *Nov.*, 1932. *In English.*—The activation of nitrogen and oxygen by means of an electrodeless ring discharge is studied, the technique being similar to that employed earlier for hydrogen [see Abstracts 2418 and 4523 (1932)], except that in this case a bulb 25 cm. dia. is employed as container for the gas. Three distinct afterglows are observed; with air at a pressure of 1 to 0·07 mm. Hg the afterglow is green, between 0·07 and 0·05 mm. it is blue, whilst below 0·05 mm. the afterglow is orange coloured. These afterglows decay at different rates. Observation of the orange afterglow shows the α–N_2 bands to be the most prominent visual feature. Photographically, however, the 3rd positive bands (γ–NO) are the strongest feature of the spectrum. The blue afterglow is stated to be due to the β-NO bands. Possible mechanisms of the discharge are discussed, and it is concluded that the theory of Cario and Kaplan [see Abstract 1649 (1930)] fits the observations best. A. H.

1987. Electrodeless Ring Discharge Through Potassium Vapour. B. Arakatsu and Y. Uemura. *Faculty of Sci. and Agric., Taihoku Imp. Univ.* 5. *pp.* 159–161, *Nov.*, 1932. *In English.*—Previous work on the electrodeless ring discharge through hydrogen in a long tube [see Abstracts **2418** and **4523** (1932)] suggested that the glow in the part of the tube outside the primary coil was due to the positive rays of the neutralising hydrogen atoms expelled from the part of the tube within the coil. The discharge in potassium vapour is now studied and it is found that no trace of the arc lines is to be seen, only spark lines are emitted. The phenomena are considered to support the theory already advanced. The mechanism of the process involved is discussed. A. H.

1988. Moving Striation and Anode Spots in Neon Tubes. T. Takamine, T. Suga and A. Yanagihara. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 403. *pp.* 63–69, *Jan.*, 1933.—The discharge through a tube containing neon at several mm. pressure is examined by means of a falling plate camera. The moving striations are photographed and a study of the light emitted by the anode spots shows that they appear intermittently even when d.c. excitation is employed. The effect of a magnetic field on the spots and striations is studied, negative results being obtained. A. H.

1989. Control by an External Magnetic Field of the Current Across a Spark-Gap. R. F. Earhart and H. A. Carlock. *Frank. Inst., J.* 215. *pp.* 179–187, *Feb.*, 1933.—An experimental study was made of the electrical discharge between parallel plates when the gas pressure between the plates had been reduced to a value slightly less than the critical pressure, *i.e.*, to the condition when a valve begins to harden. Under these conditions the application of a transverse magnetic field will produce a discharge between the electrodes for potentials less than the normal potential required. It is believed that this is due to the lengthening of the path traversed by the ions in crossing the gap. The results obtained may be harmonised by means of the values found by Carr [see Abstract 1490 (1904)] who made a study of Paschen's Law in the region of critical pressure. In general it is found possible, under the conditions studied, to start a discharge and control the value of the current through a circuit of which the gap is a part by means of varying the magnetic field superimposed on the gap and without altering either the impressed e.m.f. or the ohmic resistance of the circuit. This control is effected by altering the effective length of the spark gap in the circuit by means of the external magnetic field. AUTHORS.

1990. Influence of Axial Magnetic Fields on the Positive Column of Mercury Vapour Arcs. G. A. Kugler and A. Roggendorf. *Phys. Zeits.* 34. *pp.* 136–140, *Feb.* 1, 1933.—The tubes used in this investigation were of the wall-current amplifier type made by Siemens. The axial magnetic fields were obtained by sending suitable currents through a coil surrounding the tube and extending some distance beyond the ends of the tube, so that the mercury vapour arc took place in a magnetic field that was essentially homogeneous. Measurements were made of the potential fall in the arc and of the wall currents for different wall potentials, using different magnetising currents, and the results are presented graphically. An investigation was also made of the control anode and grid currents for magnetic control of the tube. Finally, the effect of alternating magnetic fields was investigated, the frequency being varied from 30 to 10,000 p.p.s. At low frequencies the behaviour of the tube was found to be almost the same as with step by step variation of an applied d.c. magnetising current. A. W.

1991. Effect of Steepness of A.C. Potential Rise on the Ignition Potential of the Rare Gases and Air in Discharge Tubes. W. Spielhagen. *Phys. Zeits.* 34. *pp.* 164–168, *Feb.* 15, 1933.—Research is described on the effect of the steepness of the a.c. potential rise on the ignition potential of He, Ne, A and air. The current strength and gas pressure in the discharge tube were used as parameters. It was found that both in the rare gases and in air the ignition potential decreased with increased steepness of the potential rise and tended towards a constant value. With gas mixtures the variation of the ignition potential was less, and with air greater than with the rare gases. A. W.

1992. Ignition Potential of Nitrogen with Varying Electrode Distance. H. Fricke. *Phys. Zeits.* 34. *pp.* 168–172, *Feb.* 15, 1933.—The ignition potential of nitrogen with a.c. potentials, constant pressure and electrode distance, depends largely on the steepness of the potential rise and the duration of the no-current periods. Differences of 50 % or more may be observed by change of both these variables. Consistent values of the ignition potential with varying electrode distances are only obtained when they are referred to constant steepness of the potential rise or constant duration of the no-current periods. With different durations of the no-current periods the graphs for U_Z (ignition potential) are approximately parallel straight lines, nearly parallel to that for U_B, the excitation potential. Different steepnesses of the potential rise give straight-line graphs for U_Z of different slopes, but all diverge from one point, which is the starting point of the U_B graph. U_Z is also found to decrease with decrease of pressure in the discharge tube. A. W.

1993. Ionisation and Scattering Accompanying Positive Ion Impact in Gases. C. A. Frische. *Phys. Rev.* 43. *pp.* 160–168, *Feb.* 1, 1933.—The ionisation produced by K^+ ion impact in A, Ne, He, N_2, CO, H_2 and Hg is studied for voltages ranging from O to 4000 volts. The A curve saturates, that is the ionisation in A approaches a constant maximum value as the voltage is increased, at 4000 volts. The Ne curve shows a tendency to saturate at the same voltage. The ionisation in He and H_2 is very small. N_2 and CO ionise equally well and the curves lie slightly above the Ne curve. The minimum potentials for which ionisation sets in vary from 100 volts for A to 1600 for H_2. Accurate measurement of these potentials is not attempted. It is shown that when the results are plotted against the kinetic energy of the impinging ion-molecule system (relative to its centre of mass) the various ionisation potentials show a comparatively small range. The scattering experiments show that at low voltages a few of the K^+ ions make direct impact in mercury and are reflected with 4/9 of their original energy which is the value expected from conservation of momentum and energy. Small angle scattering is also observed in this case and for K^+ and Na^+ in A. In the latter no ions are observed with an appreciable velocity in the reverse direction. The evidence indicates that the gases which ionise most readily are also the most effective as scattering agents. It is suggested that ionising collisions are glancing collisions. F. C. C.

1994. Momentum Transfer to Kathode Surfaces by Impinging Positive Ions in Helium Arc. E. S. Lamar. *Phys. Rev.* **43.** *pp.* 169–176, *Feb.* 1, 1933.—A study was made of the momentum transfer to an auxiliary kathode in the positive column of a l.t. helium arc. The auxiliary kathode was a flat molybdenum plate insulated on one side by glass and suspended so that its deflection gave a measure of the pressure against it. The measured pressure is thought to be due (*a*) to the recoil of those ions which retain some of their kinetic energy after neutralisation, and (*b*) to a radiometer effect caused by heating of the kathode by positive ion bombardment. On these assumptions the experimental data gave an accommodation coefficient for helium positive ions and the fraction of the measured current carried by electrons. The accuracy of measurement was not high, but the values of the accommodation coefficient are in qualitative agreement with the results of Compton and van Voorhis and the fraction of the current carried by electrons agrees fairly well with the results of Harrison. A. W.

1995. Electrodeless Discharges in Uniform Fields. G. D. Yarnold. *Phil. Mag.* **15.** *pp.* 294–300, *Feb.*, 1933.—Townsend's theory of the uniform positive column in d.c. discharges, when extended to cover electrodeless discharges, gives the following relation between Z, the electric force throughout the greater part of the gas, and V/*d*, where V is the p.d. between the plates and *d* their distance apart: $Z(1 + T^2I^2)^{\frac{1}{2}} = V/d$, T being a constant and I a quantity proportional to the number of electrons per $cm.^3$ of the gas. The product TI is therefore proportional to the current in the gas. I can be measured in arbitrary units by means of a photoelectric cell. Two series of measurements were made, one for discharges in a spherical bulb containing neon at various pressures, the other for discharges in cylindrical tubes containing helium at different pressures. The results show good agreement with theory for the smaller currents, the deviations at higher current values being possibly due to the photoelectric cell receiving light from the brighter parts of the discharge. A. W.

1996. Electron Rays and Gas Discharge. E. Brüche. *Ann. d. Physik,* 16. 4. *pp.* 377–403, *Feb.*, 1933.—The phenomena of electron rays and the gas discharge in the electron-ray chamber are discussed in detail, with special reference to the mechanism of the processes involved. Experimental work is then described in support of the conclusions reached in the theoretical discussion. It appears that the electron-ray chamber satisfies the conditions for Langmuir's plasma. This is clearly shown by the experiments dealing with the charge on the glass walls. A. W.

1997. Mass-Spectrograph Study of the Ionisation and Dissociation by Electron Impact of n-Octane. E. G. Linder. *J. Chem. Phys.* 1. *pp.* 129–132, *Feb.*, 1933.—A mass-spectrograph study of *n*-octane (C_8H_{18}) indicates that when bombarded by 120 e-volt electrons, it dissociates into a large number of small fragments, of which those containing two or three carbon atoms (and some hydrogen) are most numerous.

Ions containing odd numbers of H atoms are produced in larger quantities than those containing even numbers. The octane molecule displays a greater tendency to break up than does benzene [see Abstract **4540 (1932)**], which is in accordance with the reactions of these compounds in gaseous electrical discharges. AUTHOR.

1998. Ionisation by Positive Ions. J. S. Townsend and F. L. Jones. *Phil. Mag.* 15. *pp.* 282–294, *Feb.*, 1933.—A detailed account is given of experiments made to determine separately (*a*) the amount of ionisation due to collisions of positive ions with gas molecules and (*b*) the number of ions set free from the negative electrode by impact of positive ions, the electrodes being parallel plates and the gas pressure of the order of that corresponding to the minimum sparking potential. Under the conditions of test it was found that the effect of the ionisation by collision of positive ions with gas molecules was about three times that of the electrons set free from the negative electrode. The results are compared with earlier results obtained with zinc electrodes, and differences between the two sets of results are attributed to differences in the emission of electrons from the negative electrode, which in the present case was made of copper. A. W.

1999. Fundamentals of Geometrical Electron Optics. E. Brüche. *Zeits. f. techn. Physik*, 14. 2. *pp.* 49–58, 1933.—The motion of electrons in electric and magnetic fields bears an exact analogy to ordinary geometrical optics, when the wave structure of the electron is ignored. Recently this analogy has been put into practical effect by designing electric and magnetic fields which act on the electrons emitted from a surface and form an electron image of the surface in another plane. In this way an electron microscope has been constructed. An outline of the theory of electron-optical refracting elements is given, together with a discussion of the similarities and differences between practical electron optics and practical light optics. The latter employs homogeneous media bounded by geometrical surfaces of discontinuity, whereas the former works usually with inhomogeneous fields. Virtual images are valueless in electron optics, and so on. W. S. S.

2000. Theory of the Electron Microscope. L. Posener. *Zeits. f. Physik*, 80. 11–12. *pp.* 813–818, *Feb.* 23, 1933.—It is shown that a beam of electrons radiating from a point displaced from the axis of a solenoid is brought to a focus by the magnetic field of the solenoid, *i.e.*, there is stigmatic image formation as for axial points. The questions of object magnification and the existence of a refractive index are discussed. W. S. S.

2001. Geometrical Optics of Electron Rays. W. Glaser. *Zeits. f. Physik*, 80. 7–8. *pp.* 451–464, *Feb.* 6, 1933.—The path of an electron in an electromagnetic field can be treated as equivalent to that of a light-ray in an inhomogeneous anisotropic medium, and the corresponding " refractive index " is deduced. The methods of geometrical optics for anisotropic bodies can thus be applied, and the refraction law which is deduced for electron rays in the electromagnetic field is employed to derive the focus equation in the central-symmetrical magnetic field. The general Abbe sine-law is also extended to the electromagnetic field. C. B. A.

2002. Temperature Effect and its Elimination in Geiger-Müller Tube Counters. L. F. Curtiss. *Bureau of Standards, J. of Research*, 10. *pp.* 229–232, *Feb.*, 1933.—It has been found that in the usual form of the Geiger-Müller tube counter the rate of counting is affected by changes of temperature. The rate of counting, at a fixed potential applied to the tube, decreases as the temperature is increased. This indicates an increase in the density of the gas in the counter. Since it is hermetically sealed this can only be caused by evaporation of volatile material within the counter. The hard-rubber insulators commonly used in these counters are practically the sole source of such volatile material, consequently a form of counter has been devised in which only glass and metal are used and which does not have its rate of counting affected by changes of temperature. AUTHOR.

2003. Kinematographic Study of the Discharge through Discharge Tubes. V. Dolejšek and K. Dráb. *Comptes Rendus*, 196. *pp*. 334–336, *Jan*. 30, 1933.—A description is given of kinematographic observations (240 exposures per second) of the discharge through a low-voltage (1000 volts), high-intensity discharge tube [see Abstract 2855 (1932)]. The importance of using a kathode of large area is demonstrated; if the kathode is too small it is impossible to maintain the temperature below the critical value above which the normal discharge cannot exist. H. F. G.

2004. New Design for a H.T. Discharge Tube. L. C. van Atta, R. J. van de Graaff and H. A. Barton. *Phys. Rev.* 43. *pp*. 158–159, *Feb*. 1, 1933.—A description is given of tests with a h.t. tube of simple and rugged design. The tube consists essentially of a fibre cylinder extending between the electrodes and evacuated to a pressure of 4×10^{-6} mm. of Hg. A potential of 300,000 V could be maintained on a section of tube 53 cm. long. In spite of the fact that the voltage was limited by the discharge there was no sign of puncture. In order to permit the application of extremely high voltages to the tube a method of screening the electrodes to prevent breakdown is suggested. F. C. C.

See also Abstracts 1668, 1843, 1864, 1880, 1999, 2052.

CONDUCTION IN SOLIDS AND LIQUIDS.

2005. Flow of Electric Current in Semi-Infinite Stratified Media. L. V. King. *Roy. Soc., Proc.* 139. *pp*. 237–278, *Feb*. 1, 1933. The problem is considered on account of its applications to electrical methods of geophysical prospecting. In its general form, the medium is supposed to be bounded by a plane, and the conductivity to vary in an arbitrary manner provided that it is a function only of the distance from this plane and of no other variable. There is a similar problem for the cylinder and sphere. The problems treated in detail include (1) two media of different conductivities, bounded by an insulating plane, (2) a layer of finite thickness, bounded by a semi-infinite medium, and (3) a layer of finite thickness embedded in a semi-infinite medium. In each case, the value of the potential gradient at the surface (the observable quantity in the practical application) is evaluated, usually in the form of a rapidly convergent series. J. H. A.

2006. Electrical Conductivity of Uranium Dioxide and its Use as a Series Resistance. W. Meyer. *Zeits. f. techn. Physik*. 14. 3. *pp*. 126–128, 1933.—The resistance of UO_2 over a range of temperature from 22° C. to 327° C. is given. From the magnitude of the resistance and the temperature coefficient, but chiefly on account of the invariability of its electric constants in a vacuum or in reducing or indifferent gases, this substance is suitable for use as a series resistance and for current regulating purposes with an iron-hydrogen resistance. J. J. S.

2007. Migration Constants of Solid Alkali Halides. W. Jost and H. Schweitzer. *Zeits. f. phys. Chem.* 20. *Abt.B.* 1–2. *pp.* 118–124, *Feb.*, 1933.—The relative motion of anions and kations in solids is here found by the change in length of a cylinder of compressed sodium chloride and other alkali halides when a current is passed down the cylinder. Measurements are made at temperatures up to 600° and 700° C. The results are in agreement with the considerations of other workers that both the anion and the kation take part in the conduction. H. M. B.

2008. Electrical Conductivity of Tridymite and Cristobalite at their Transformation Temperatures. S. Shimizu. *Tohoku Univ., Sci. Reports*, 21. *pp.* 882–905, *Dec.*, 1932. *In English.*—The conductivity of a β-quartz plate cut parallel to the optical axis changes abruptly when the transformation to cristobalite occurs (870° C.); if the plate is cut perpendicular to the axis, on the other hand, the change of conductivity is continuous between 600° and 1000° C. Measurements with a specimen of silica brick show that the conductivity of tridymite varies anomalously during the transformation which occurs between 100° and 200° C. After exhibiting irregular variations up to 190° C. the conductivity falls to a low value at 210° C. and then rises abruptly; if the specimen is subsequently cooled slowly the heating curve is followed to 210° C., but at this temperature a break occurs and an extremely high peak appears at 190° C. With cristobalite the conductivity-temperature curve exhibits a discontinuity at 236–246° C. H. F. G.

2009. Conductivity of Nitric and Perchloric Acids and Mobility of the Hydrogen Ion. M. Hlasko and W. Klimowski. *Acad. Polonaise Sci. et Lettres, Bull.* 8–9A. *pp.* 257–266, *Oct.–Nov.*, 1932. *In French.*—The coefficients of conductivity at 25° of nitric and perchloric acids have been determined for 11 concentrations from $N/2$ to $N/2048$; they are identical for concentrations $< N/32$, near to those of HCl, HBr, and HI, and about 1 % < those calculated by Onsager's formula. The limiting mobilities of the hydrogen ion deduced from these results are 355·1 and 355·0 respectively. [See also Abstracts 2642 (1927) and 349 (1929).] C. A. S.

2010. Properties of Electrolytic Solutions. Part II. Evaluations of Λ_0 and of K for Incompletely Dissociated Electrolytes. R. M. Fuoss and C. A. Kraus. *Am. Chem. Soc., J.* 55. *pp.* 476–488, *Feb.*, 1933.—An exact method is deduced for solving the conductance equations for incompletely dissociated binary electrolytes, and for determining the limiting equivalent conductance and the dissociation constant. Applications of the method are given, in which the constants of the solvent and electrolyte vary as widely as possible, to sets of conductance data of the following: iodic acid in water; sodium bromate in ammonia; sodium iodide in amyl alcohol; tetra-isoamyl-ammonium nitrate in ethylene dichloride; potassium amide in ammonia. Calculated and observed conductance values agree within the limit of experimental error up to ion concentrations of approximately 2×10^{-3} *N*. [For Part I see Abstract 1604 (1933).] N. M. B.

2011. Electrical Conductivity of Aqueous Solutions of Sodium and Potassium Hydroxides and the Limiting Mobility of the Hydroxyl Ion at 25°C. G. H. Jeffery and A. I. Vogel. *Phil. Mag.* 15. *pp.* 395–408, *Feb.*, 1933. *Supplement.*—A series of measurements of the conductivity of solutions of sodium and potassium hydroxides was made in order to provide trustworthy data and fill a gap in the literature. The solutions were carefully prepared from sodium and potassium metal, the subsequent dilutions being carried out by means of accurately calibrated burettes. The results of the conductivity measurements are compared with previously published results, and the discrepancies are discussed. F. J. B.

2012. Conductivity Measurements in Nitro Compounds. Part I. Measurements in Nitromethane. Part II. Measurements in Nitrobenzene. P. Walden and E. J. Birr. *Zeits. f. phys. Chem.* 163. *Abt.A.* 3–4. *pp.* 263–290, *Feb.*, 1933.—The density and internal friction of nitromethane which had a conductivity of 2 to 4 × 10^{-1} were determined at 0°, 25° and 50°. The same constants were determined for nitrobenzene, which had a conductivity of 2 × 10^{-8} at 25° C. The conductivity of tetraethylammonium picrate was measured at 0°, 25° and 50° C. The conductivities of a number of salts in solution in nitromethane were determined at dilutions up to 20,000 litres at 25° C. The conductivities of tetraethylammonium picrate, chloride, bromide, iodide, perchlorate, diethylammonium picrate, chloride, lithium picrate, sodium picrate, potassium picrate, and silver picrate were determined at 25° C. up to dilutions of 50,000 litres. F. J. B.

2013. Anomalous Electrolytes. Part I. Electrical Conductivity of Solutions of Iodine and Cyanogen Iodide in Pyridine. L. F. Audrieth and E. J. Birr. *Am. Chem. Soc., J.* 55. *pp.*668–673, *Feb.*, 1933.—Both iodine and cyanogen iodide dissolve in pyridine to give solutions whose electrical conductivity increases with time to give maximum values. The experimental evidence indicates that reaction between solvent and solute results in the primary formation of a non-conducting addition compound which in time changes over to a true quaternary pyridonium salt. In the case of iodine the extraordinarily high value for the molecular conductivity at infinite dilution can only be explained by the formation of a ternary salt. H. H. Ho.

2014. Mechanism of Current Conduction in Dielectric Liquids. A. Nikuradse. *Zeits. f. Physik*, 77. 3–4. *pp.* 216–234, *July* 26, 1932.—In pure dielectric liquids with clean electrodes saturation currents exist. After the passage of the saturation region of the current-potential characteristic curve, which in pure liquids extends to about 10^5 volt/cm., the current begins to rise very strongly with increasing field-strength. This limiting field-strength has, *e.g.*, in pure toluol the value of about $1 \cdot 2 \times 10^5$ volt/cm. On rise of the field-strength by about one power electric spark discharge commences. The disruptive field-strength in toluol amounts to about $1 \cdot 3 \times 10^6$ volt/cm. The deviation from the exponential law is confirmed and further examined [see Abstracts 3387 and 4465 (1932)]. The dependence of the ionisation number and of the accumulation coefficient on the field-strength is quantitatively investigated. Agreement between theory and experiment is pointed out. J. J. S.

2015. Conduction of Electricity with High Fields in Dielectric Liquids. A. Nikuradse. *Phys. Zeits.* 34. *pp.* 97–114, *Feb.* 1, 1933.—A review and summary of the results of researches on this subject. It is considered under the following divisions: (1) Influence of suspensions and colloidal solutions, (2) Dependence of the current strength on time, (3) High frequency conductivity, (4) Mechanism of current conduction with high fields, (5) Dependence of the current strength on the superficial extent of the electrodes, (6) Polarity effect, (7) Influence of temperature, (8) Influence of pressure, (9) Glow phenomena, current discharge from points, (10) Potential distribution with high fields. In conclusion a Bibliography of papers on the subject is given. J. J. S.

2016. Conductivity of Polarisable Media. G. Jaffé. *Ann. d. Physik*, 16. 2. *pp.* 217–248, *and* 16. 3. *pp.* 249–284, *Feb.*, 1933.—The conception of the phenomenon which is developed is that a polarisable medium contains two sorts of ions: (1) ions of the first kind which cannot leave the dielectric, and (2) ions of the second kind with the usual limiting conditions. An extended mathematical discussion is given of these two cases commencing with the treatment of the stationary problem with consideration of the formation of ions, their reunion, diffusion and wandering in the field. J. J. S.

See also Abstracts 1739, 1939, 2062, 2063, 2094.

DIELECTRICS AND CAPACITANCE.

2017. Dielectric Loss in Glasses in Relationship to their Composition. F. Keller. *Zeits. f. techn. Physik*, 14. 3. *pp.* 128–131, 1933.—This paper extends Gehlhoff's and Thomas's work [see Abstract 3368 (1932)], and records the dielectric loss in glasses as determined by a calorimetric method. The dependence of the dielectric loss on the voltage and frequency is investigated in connection with the composition of the glasses and the influence of the glass-forming oxides: Na_2O, K_2O, CaO, BaO, PbO, ZnO, MgO, B_2O_3, Al_2O_3, and Fe_2O_3. H. H. Ho.

2018. Dipole Rotation in Certain Crystalline Solids. S. E. Kamerling and C. P. Smyth. *Am. Chem. Soc., J.* 55. *pp.* 462–465, *Feb.*, 1933.—A low-frequency capacity bridge is used to measure the dielectric constants of certain crystalline solids over a range of temperature down from the melting point and at frequencies from 200 to 50,000 cycles. Heptyl bromide, hydroquinone dimethyl ether and anisole show no turning of the molecules or of their polar groups in the externally applied field, while in phenol and benzoyl chloride, effects which might indicate such turning are attributed to the presence of small quantities of impurities. The atomic polarisations of *n*-heptyl bromide, *p*-hydroquinone dimethyl ether and phenol are calculated to be 14, 5 and 5·5 respectively. H. H. Ho.

2019. Electric Moments of Hydrazine and its Derivatives. L. F. Audrieth, W. Nespital and H. Ulich. *Am. Chem. Soc., J.* 55. *pp.* 673–678, *Feb.*, 1933.—The following electric moments are recorded: hydrazine (1·83–1·85), phenylhydrazine (1·63–1·79), *a, a*– phenylmethylhydrazine (1·79), *a, a*– diphenylhydrazine (1·87), hydrazobenzene (1·53), benzaldehydephenylhydrazone (1·97), benzalazine (1·00), each $\times 10^{-18}$ e.s.u. H. H. Ho.

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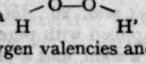
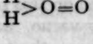
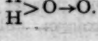
2020. Dependence of the Dielectric Constants of Gases on Temperature and Density. H. H. Uhlig, J. G. Kirkwood, and F. G. Keyes. *J. Chem. Phys.* 1. *pp.* 155–159, *Feb.*, 1933.—Using essentially the apparatus described in earlier papers [see Abstracts 217 (1931) and 1341 (1931)] the authors have repeated the measurements on carbon dioxide and ammonia, and have made measurements on hydrogen, nitrogen and methane. With carbon dioxide and ammonia it is found that the molar polarisations increase slowly with the density, whilst it is entirely independent of the density of the other gases. The molar polarisations of carbon dioxide, methane, nitrogen, and hydrogen are independent of temperature, indicating that these molecules possess no permanent dipoles. For ammonia the molecular polarisation is strongly dependent on temperature, and the dipole moment has been calculated as $1 \cdot 48 \times 10^{-18}$ e.s.u. No satisfactory quantitative explanation for the variation of the molecular polarisations of carbon dioxide and ammonia with density has been obtained so far, and the nature of further work to elucidate this is indicated. W. R. A.

2021. Electric Polarisation in Vapours. U. Grassi. *N. Cimento*, 10. *pp.* 3–20, *Jan.*, 1933.—If a is the ratio of the electric moment per unit volume, when a gas is polarised, to the field F producing the polarisation, then the molecular polarisation is defined as $Pm = 4 \pi N a/3$, where N is Avogadro's number. Debye has shown that $Pm = A + B/T$, where A and B are connected respectively with the action of field on the outer and inner electrons. If this formula is joined to that of Mossotti, $Pm = (K - 1) M/(K + 1)d$, where K, M and d are the dielectric constant, molecular weight and density, then A and B can be found from measurements of K. Phosphorus trichloride gives anomalous results. In particular, the energy levels and consequently the calculated optical term values are distinctly too high. An investigation based on quantum theory is carried out to ascertain the cause of the discrepancy. J. H. A.

2022. Dielectric Polarisation of Solutions of Sulphur in Carbon Disulphide. S. Dobinski. *Acad. Polonaise Sci. et Lettres, Bull.* 8–9 *A. pp.* 239–247, *Oct.–Nov.*, 1932. *In French.*—The author describes a very accurate experimental determination of the dielectric polarisation of sulphur dissolved in carbon disulphide, which is found to be independent of the concentration, contrary to the previous results of Rosental, and does not undergo abrupt change with change of phase. The value submitted is $P_s = 0 \cdot 252$ cm.^{3}/gm. H. H. Ho.

2023. Dipole Moment of Hydrogen Peroxide. W. Theilacker. *Zeits. f. phys. Chem.* 20. *Abt.B.* 1–2. *pp.* 142–144, *Feb.*, 1933.—It is shown that the dipole moment of hydrogen peroxide indicates the symmetrical formula  $\mathrm{H{\diagup}O{-}O{\diagdown}H}$, with the assumption of an angle of 110° between the oxygen valencies and free rotatability of both OH— groups about the O—O axis, rather than the formulæ  $\genfrac{}{}{0pt}{}{\mathrm{H}}{\mathrm{H}}{>}\mathrm{O{=}O}$ and  $\genfrac{}{}{0pt}{}{\mathrm{H}}{\mathrm{H}}{>}\mathrm{O{\rightarrow}O}$. H. H. Ho.

2024. Dielectric Constant of Liquid Sulphur. H. J. Curtis. *J. Chem. Phys.* 1. *pp.* 160–165, *Feb.*, 1933.—The dielectric constant and power factor of liquid sulphur were measured by a bridge method at four different audio-frequencies and over the temperature range 118° C. to

350° C. The dielectric constant was found to be independent of frequency and equal to $3 \cdot 520 \pm 0 \cdot 010$ at 118° C. A study of the polarisation curve shows that liquid sulphur is non-polar. A method was developed for differentiating between that part of the power factor which is due to conductivity and that which is due to molecular friction. The former was found to be large at high temperatures and the latter small at all temperatures. The infra-red spectrum of liquid sulphur contains definite absorption bands, which fact shows that its molecules are polar. It is difficult to understand this contradiction, since both measurements seem to give conclusive results. AUTHOR.

2025. Orientation of Non-Polar Molecules by Dipoles. J. Weigle. *Helv. Phys. Acta,* 6. 1. *pp.* 68–81, 1933. *In French.*—The influence of the electric field of a dipole upon the non-polar molecules of the medium in which it is dissolved is calculated. If the non-polar molecules are anisotropic, they are orientated by the dipole and produce an electric moment which is added to that of the dipole. This additional moment is of the order of magnitude of 1 % of that of the dipole. If the polar molecule is not spherical, the polarisation of the neighbouring molecules then produces a considerable moment in the reverse sense of the dipole. The latter effect, which must be taken into account in measurements of electric moments, appears to give a reasonable explanation of the variations observed of the dipole moment in different solvents [see Abstract 361 (1933)]. H. H. Ho.

2026. Dependence of Dipole Moment of Dichloroethane on the Temperature and Solvent. S. Mizushima and K. Higasi. *Imp. Acad. Tokyo, Proc.* 8. *pp.* 482–485, *Dec.,* 1932. *In German.*—Measurements of the dielectric constant of solutions of dichloroethane in ether have been made by a crystal oscillator method using a wave-length of 100 m. in the temperature range −60° C. to 20° C. Values of the electric moment have been calculated, and these observed values are in good agreement with values computed on the assumption that the interaction between the two CH_2Cl groups is not weak enough to permit of free rotation and not strong enough completely to hinder free rotation. In this way a temperature effect is encountered, the value of the electric moment increasing with increase in temperature. An interesting calculation of the values of the electric moment of this substance in the vapour phase and in heptane solution is given, and these values also exhibit the temperature effect ; change of state has a big influence on the order of magnitude of the moment and so has the solvent. These differences are ascribed to variation in the value of the potential energy. W. R. A.

2027. Method for the Determination of the Dielectric Constants of Powders. K. Højendahl. *Zeits. f. phys. Chem.* 20. *Abt.B.* 1–2. *pp.* 54–64, *Feb.,* 1933.—The mixture method is applied with pure liquids for the measurement of the dielectric constant of a solid, and a process is described for a powder based on this principle. The dielectric constants of ether, chloroform, chlorobenzene, and ethylene chloride are measured over a wide temperature range, the two last named in the solid state also, and interpolation formulæ are given. The solids measured are : the chlorides of sodium, potassium, rubidium and cæsium, the bromides and iodides of rubidium and cæsium, and the oxides of copper and silver. H. H. Ho.

2028. Polarity in Certain Hydrocarbon Vapours. K. B. McAlpine and C. P. Smyth. *Am. Chem. Soc., J.* 55. *pp.* 453–462, *Feb.*, 1933.—An apparatus for the accurate measurement of the dielectric constants of gases and vapours has been constructed and tested by repeated measurements upon air and carbon dioxide. Values have been determined for benzene, toluene, propane and propylene, and used to calculate their polarisations and electric moments. The absence of any change in the polarisations of benzene and propane with rising temperature indicates that the increase previously observed in a number of liquid paraffins is due to decrease in intermolecular action. The zero moment found for the benzene molecule agrees with the less accurate results of the measurements upon the liquid and with the symmetrical structure of the molecule. The zero moment found for propane is consistent with the absence of moment in the higher members of the series, and shows that any polarity in the C—C bonds, electrical dissymmetry caused by repulsion in the molecule or difference in electro-negativity between the hydrogens on the secondary and those on the primary carbons is too small for detection by means of the electric current. The small moments found for toluene and propylene are of the same magnitude as those which might arise from inductive effects in the molecules. H. H. Ho.

2029. Rôle of Dissolved Gases in Determining the Behaviour of Mineral Insulating Oils. F. M. Clark. *Frank Inst., J.* 215. *pp.* 39–67, *Jan.*, 1933.—The characteristics of a gas solution in mineral oil are discussed, and data in regard to the variation of gas solubility with temperature and pressure are given. An efficient method for degassing a mineral oil is described which consists of allowing a fine spray of the oil to pass into an evacuated vessel. Results of tests show that the dielectric strength of oil is dependent on the kind and amount of its dissolved gas, and the dielectric strength-gas content relationship resembles the recognised dielectric behaviour of air itself. It is suggested that the usual dielectric strength of oil measures only the ease of oil " gassing," *i.e.*, the ability for gas bubbles to form due to the applied field, the gas being either a dissolved impurity or the vapour of the lighter oil constituents. It is concluded that investigations of the process of electric breakdown in liquids with a view to applying advanced molecular theories are useless unless the influence of dissolved gases is entirely eliminated. A. M.-T.

See also Abstracts 1701, 1943.

ELECTROCHEMISTRY.

2030. Diffusion in Standard Cells. G. A. Hulett and R. B. Elliott. *J. Phys. Chem.* 37. *pp.* 245–252, *Feb.*, 1933.—Experiments are described showing that diffusion of mercury ions in standard cells (Clark, cadmium saturated, and Weston) is considerable, and is apparently greater when the depolariser consists of crystallised than when of electrolytic mercurous sulphate. In two cadmium cells with the latter made 18 and 4 years ago a steady state had been reached in the older, but not in the younger cell. When therefore hydrolysis of mercurous sulphate is possible diffusion may be an important factor in e.m.f. change. C. A. S.

2031. Lead-Mercurous Acetate Voltaic Cell with Acetic Acid as Solvent. G. Tarbutton and W. C. Vosburgh. *Am. Chem. Soc., J.* 55. *pp.* 618–624, *Feb.*, 1933.—Lead-mercurous acetate voltaic cells were set up with solvents covering a wide range of acetic acid-water mixtures and including nearly anhydrous acetic acid, and with three different solid phases. Duplicate cells with nearly pure acetic acid as the solvent could be reproduced to within 0·1 millivolt, and were constant in e.m.f. for several months. F. J. B.

2032. E.M.F. of Cu-Hg Cell. (Miss) Quintin. *Comptes Rendus,* 196. *pp.* 473–475, *Feb.* 13, 1933.—Examines the combination

$$- \text{Cu (amalgam 2 phases)} ; \text{CuSO}_4, c/\text{Hg}_2\text{SO}_4 \text{ (solid)} ; \text{Hg} +$$

with the object of discovering the coefficient of activity of copper sulphate at 25° and at different concentrations c. The e.m.f. of the combination was 0·3514 at a concentration of 1·1300 mol. gm./litre, 0·3951 volt with $c = 0\cdot02825$, and 0·4325 volt with $c = 0\cdot00133$. *Errata.* ibid. *p.* 652, *Feb.* 27, 1933. E. E. F. d'A.

2033. Electrochemical Oxidation of Anthraquinone. C. H. Rasch. *Univ. Pittsburgh, Bull.* 29. *pp.* 192–198, *Jan.* 10, 1933.—Hydroxylated anthraquinones were produced by the electrolytic oxidation of anthraquinone in solution in strong sulphuric acid. Boric acid did not improve the electrochemical oxidation. The hydroxylated anthraquinones produced by the reactions were separated into fractions. Spectroscopic determinations showed that the hydroxylated anthraquinones produced were mixtures. F. J. B.

2034. Electrochemical Oxidation of Naphthalene. E. G. White. *Univ. Pittsburgh, Bull.* 29. *pp.* 256–261, *Jan.* 10, 1933.—The electrochemical oxidation of naphthalene was studied with a new type of electrode consisting of platinum gauze covered with a mixture of 60 % naphthalene and 40 % carbon. The electrode was heated to 105° C. for five minutes and then compressed, it was next suspended in 1 % sulphuric acid and the electrolytic oxidation carried out at 0·5 ampere for 5·51 ampere-hours. The products were analysed and the α-naphthoquinone estimated. The yields of α-naphthoquinone were higher than those obtained by previous investigators. F. J. B.

2035. Electrolytic Oxidation of Leuco-Bases of the Triphenylmethane Series. G. H. White, Jr. *Univ. Pittsburgh, Bull.* 29. *pp.* 262–272, *Jan.* 10, 1933.—The leuco-bases were mixed with carbon and pressed on to platinum gauze and the electrolyte was a solution of sodium sulphate. The leuco-bases of four triphenylmethane dyes were oxidised by two different methods which were general methods for the whole series. Those insoluble in water were oxidised as solid depolarisers in carbon and leuco-base mixtures, and those soluble in water or alkalies were oxidised in a solution of sodium carbonate when used as soluble depolarisers. F. J. B.

2036. Debye-Hückel Ion Size Parameter in Terms of Individual Ionic Radii. Activity Coefficient of Lead Chloride in Solutions of Cadmium Nitrate. H. D. Crockford and H. C. Thomas. *Am. Chem. Soc., J.* 55. *pp.* 568–574, *Feb.*, 1933.—The ion-size parameter of the Debye-Hückel theory of solutions of strong electrolytes has been previously determined as a mean value for the ions of a given solution. Calculation of the parameter a from the individual ionic radii and experimental verification of the calculation would confer added physical significance on a. It is now shown that the mean distance of closest approach of the ions in dilute solutions of strong electrolytes may be obtained as a function of quantities depending on the valency types of the dissolved compounds and the size of the individual ions. The activity coefficients of lead chloride in cadmium nitrate solutions have been determined at six different concentrations, the ratio between the concentrations of lead chloride and cadmium nitrate being kept constant. The data obtained are used as a preliminary test of the above calculation. T. H. P.

2037. Dissociation Constant of Acetic Acid from 0° to 60° C. H. S. Harned and R. W. Ehlers. *Am. Chem. Soc., J.* 55. *pp.* 652–656, *Feb.*, 1933.—It was shown in a previous paper [see Abstract 3506 (1932)] that the dissociation constant of a weak acid could be determined by the e.m.f. measurement of certain concentration cells. Measurements of the cells $H/HAc(m_1)$, $NaAc(m_2)$, $NaCl(m_3)/AgCl/Ag$ were carried out at 5° intervals from 35° to 60° C. Calculation of the dissociation constant from the measurements gave $1 \cdot 754 \times 10^{-5}$ in close agreement with the value obtained by MacInnes and Shedlovsky. F. J. B.

2038. Electrolytic Transport of Water in Sodium Iodide Solutions. G. Baborovský and A. Wagner. *Zeits. f. phys. Chem.* 163. *Abt.A.* 2. *pp.* 122–132, *Jan.*, 1933.—The electrolytic transport of water and the true transport number of sodium ions were determined in molar and 0·1 molar solutions of sodium iodide. From the results the hydration numbers of the sodium and iodine ions were calculated for molar solutions. The behaviour of parchment paper membranes in the electrolysis of solutions of the alkali, alkaline earth metals and the halogen acids was shown to be partly due to the reduction of the mobility of the ions by adsorption. F. J. B.

2039. Stick Antimony Electrode for Hydrogen-Ion Determinations. T. Uemura and H. Sueda. *Chem. Soc. Japan, Bull.* 8. *pp.* 1–10, *Jan.*, 1933.—Stick antimony electrodes and the form of glass vessel used by Vles and Vellinger were employed for the determination of hydrogen-ion concentrations. In unstirred solutions the antimony electrode was found to give reliable measurements of *p*H values, from 1 to 9 inclusive. The e.m.f. in millivolts measured against the saturated calomel electrode was found to agree with the equation $E = 53 \cdot 8pH - 0 \cdot 7$. F. J. B.

2040. Electrochemical Investigation of Cadmium-Silver Alloys. A. Ölander. *Zeits. f. phys. Chem.* 163. *Abt.A.* 2. *pp.* 107–121, *Jan.*, 1933.—The potential of cells Cd (liquid)/(Li, Rb, Cd) Cl/(Cd, Ag) solid was measured and their temperature coefficients were determined; 71 alloy electrodes were employed and the measurements were carried out at temperatures between 330° and 555° C. The equilibrium diagram of the cadmium-silver system was completed. A new transition point was observed, and one previously observed was examined more exactly. The heat of the transitions was calculated. F. J. B.

2041. Kinetics of Electrode Processes. Part II. Reversible Reduction and Oxidation. J. A. V. Butler and G. Armstrong. *Roy. Soc., Proc.* 139. *pp.* 406–416, *Feb.*, 1933.—The kinetics of the electrolytic reduction of methylene blue solutions, and of the reduction and oxidation of quinhydrone solutions at platinum electrodes have been investigated. A transition process has been observed over the whole range of currents and of concentrations, which has been ascribed to the depletion of the depolariser in the vicinity of the electrode. An expression for the rate of change of the concentration of the depolariser in the vicinity of the electrode has been obtained, which is in accordance with the facts. [For Part I see Abstract 5349 (1932).] AUTHORS.

2042. Influence of H.F. Currents on Polarised Electrodes. Part II. S. Glasstone and G. D. Reynolds. *Faraday Soc., Trans.* 29. *pp.* 399–409, *Feb.*, 1933.—A study of the effect of h.f. oscillations on the limiting current for electrode efficiency of 100 % [see Abstract 4692 (1932)] shows that the h.f. effect cannot be due to its influence on the chemical reaction at the electrode, but is related to an increase in the rate of diffusion of the depolariser. The relative h.f. effect on the limiting current is independent of the surface tension of the electrolyte, although it is increased by increase in the viscosity: the effect is diminished by either stirring the solution or raising its temperature. Addition of neutral salts increases the conductance of electrolyte used and also brings about a marked decrease in the h.f. effect. This observation has been accounted for by showing that, under very widely varying conditions, the relative h.f. effect on the limiting current is proportional to the square root of the power extended in the solution per unit area of electrode surface. The h.f. effect is probably caused by mechanical disturbance produced in the electrolyte, not by local heating at the electrode, but by oscillatory rotation of the molecular dipoles constituting the water used as solvent. T. H. P.

2043. Initial Electrolytic Overvoltage of the Disengagement of Hydrogen on Mercury. R. Dufour. *Comptes Rendus*, 196. *pp.* 483–485, *Feb.* 13, 1933.—Study of the electrolytic overvoltage of mercury in definite conditions of reversible equilibrium seems to indicate that the initial overvoltage is zero. T. H. P.

See also Abstracts 1958, 2009.

ELECTRONS AND PROTONS.

2044. Most Probable Values of the Atomic Constants e and h. R. Ladenburg. *Ann. d. Physik*, 16. 4. *pp.* 468–472, *Feb.*, 1933.—Consideration of the most reliable values, other than those due to Millikan, for e and h give $e = 4{\cdot}770 \pm 0{\cdot}004 \times 10^{-10}$ e.s.w., and $h = 6{\cdot}547 \pm 0{\cdot}009 \times 10^{-27}$ erg. sec. The value for e is identical with that originally given by Millikan. These values give $137{\cdot}307 \pm 0{\cdot}048$ for the reciprocal of the fine structure constant, in disagreement with Eddington's suggested value, 137. F. C. C.

2045. Stopping Power of Matter for Swiftly Moving Charged Particles. F. Bloch. *Ann. d. Physik*, 16. 3. *pp.* 285–320, *Feb.*, 1933.—The stopping power of matter for swiftly moving charged particles is worked out for the case when the reaction on the particle of the atoms forming the matter can be neglected. A formula is obtained for the relativistic and non-relativistic cases which holds for sufficiently high velocity v of the moving particle of charge E. For very small or very large values of eE/hv, the formula breaks down into the formulæ of Bethe and Møller or of Bohr respectively. G. G. S.

2046. Efficiency of Secondary Electron Emission. S. R. Rao. *Roy. Soc., Proc.* 139. *pp.* 436–447, *Feb.* 1, 1933.—A study is made of the secondary electron emission produced by bombardment of metal faces with a beam of primary electrons. The calculated efficiencies of the secondary emission at different voltages resemble those of soft X-rays. For a polycrystalline nickel face and the 100 face of a single crystal of nickel the efficiencies determined experimentally are found to be nearly equal to each other at potentials below 150 volts. The results are discussed at length and the suggestion is put forward that the observed saturation tendencies in the soft X-ray intensity curves at about 3000 volts are due to the photoelectric methods of measurement employed. A. H.

2047. Scattering of Similar Particles. T. Sexl. *Zeits. f. Physik*, 80. 9–10. *pp.* 690–692, *Feb.* 16, 1933.—A generalisation is given of a result of Mott [see Abstract 2414 (1930)] and in the case of particles of the same kind acting on each other according to Coulomb's law the respective multiplying factors are given for changing from the number of particles to be expected according to Newtonian mechanics to the number found by wave mechanics (1) when the particles satisfy Bose's statistic, and (2) when the particles satisfy Fermi's statistic. J. J. S.

2048. Photographs of Electron Scattering by Finely Divided Crystalline Carbon. F. Trendelenburg. *Naturwiss.* 21. *pp.* 173–177, *Feb.* 24, 1933.—Well defined interference patterns can be obtained from electronic beams diffracted by carbon powders so fine as to give no X-ray diffraction patterns and therefore generally thought to be amorphous. F. J. W.

See also Abstracts 1700, 1747, 1754, 1755, 1757, 1872, 1873, 2000, 2001.

ELECTROSTATICS.

2049. Contact Potential of Zinc Crystals. W. A. Zisman and H. G. Yamins. *Physics*, 4. *pp.* 7–9, *Jan.*, 1933.—Single crystals of pure zinc were cleaved along the basal plane and the contact potential difference with a standard electrode, consisting of a gold plate well aged in air, was observed as it varied with time. Measurements of the p.d. were made with the vibrating condenser method of Zisman [see Abstract 4460 (1932)]. Thus it is proved for the first time that it is possible to obtain a reproducible contact p.d. on zinc in air at ordinary pressures. It is suggested that the lack of reproducibility of the Volta effect of turned or scraped surfaces of zinc is due to an anisotropy of the zinc crystals with respect to the Volta effect, and not due to condensation phenomena accompanying the roughness of the surface. Confirmatory evidence was found in the reproducibility of the contact p.d. of turned and scraped copper surfaces. Ende's suggestion that emery imbedded in the metals gives rise to false p.d. was found to be correct. Emery increased the p.d. between zinc and gold by about 0·4 volt, and rouge decreased it by about 0·5 volt. J. J. S.

2050. Quantitative Theory of the Wimshurst Static Machine. A. W. Simon. *Rev. Sci. Instruments*, 4. *pp.* 67–74, *Feb.*, 1933.—Following the general method of previous papers on the theory of static machines the quantitative theory of an eight carrier (per disc), birotational Wimshurst static machine is developed in detail. From the equations connecting the charges on the elements of the machine after any number of eighth turns, the equations connecting the corresponding voltages are deduced, and from these finally the general formulas for the potentials after any number of eighth turns. Provided the original potentials are in proper relation, the voltages increase by a constant factor (per eighth turn), and this factor is the same for all of the conductors of the machine. If the original potentials are not regularly distributed, the machine tends continually toward a state in which they are, and the corresponding formulæ contain transient terms. The theory is extended to polysymmetric static machines of the same general type. A trisymmetric Wimshurst machine is treated in detail. It is shown that in general Wimshurst machines with an *even* number of symmetries are direct-current machines, while those with an *odd* number are electrostatic alternators. [See following Abstract.]

AUTHOR.

2051. Quantitative Theory of the Toepler-Holtz Static Machine. A. W. Simon. *Rev. Sci. Instruments*, 4. *pp.* 75–82, *Feb.*, 1933.—The complete quantitative theory of an eight-carrier bisymmetric Toepler-Holtz static machine with output circuit is developed. The original potentials being considered as given, the potentials (and charges) corresponding to any subsequent angle of rotation are calculated, inclusive of the transient state which occurs when the carriers make contact with the brushes. In the permanent or stable state the potentials (and charges) increase by a constant factor per eighth revolution, this factor being a function of the electrostatic coefficients of the elements of the machine in the configuration where they just break contact with the brushes; also in the permanent state the potentials of similarly placed elements are equal in value but opposite in sign. The transient currents which flow when the carriers make contact with the brushes are exponentials, the time constants being functions of the resistances and potential coefficients (or, inversely, capacity coefficients) involved in the machine. The energy formula is derived and applied to a determination of the energy loss occurring when the various conductors share charges. Finally, it is indicated how the theory can be applied to various other forms of static machines of the Toepler-Holtz type. The general method developed is applicable, moreover, to any sectored static machine. [See also Abstract 2613 (1930) and preceding Abstract.]

AUTHOR.

2052. Electrostatic Production of High Voltage for Nuclear Investigations. R. J. van de Graaff, K. T. Compton and L. C. van Atta. *Phys. Rev.* 43. *pp.* 149–157, *Feb.* 1, 1933.—A new electrostatic generator of very high voltage is described. Two hollow metal spheres of aluminium alloy, 15 ft. in diameter and ¼ inch thick are used; these are supported by hollow Textolite towers 28 ft. high and 6 ft. in diameter, which are themselves carried on trucks travelling on railway lines. One of the spheres is fed by a belt carrying electricity from earth potential and depositing it on the interior of the sphere. This generator works in air at 10^7 volts and has an estimated output of 20 kW. Other generators working at 80,000 and $1{\cdot}5 \times 10^6$ volts are described; a similar generator is designed to operate in a highly evacuated tank. Methods are described for depositing the electric charge on the belts either by external or by self-excitation. The upper limit of the attainable voltage is set by the breakdown strength of the medium surrounding the sphere and by its size. The upper limit to the current is set by the rate at which belt area enters the sphere, carrying a surface density of charge whose upper limit is that which causes a breakdown field in the surrounding medium. The voltage and current each vary as the breakdown strength of the surrounding medium and the power output as its square. Also the voltage, current and power vary respectively as the 1st, 2nd, and 3rd powers of the linear dimensions.

F. C. C.

2053. Ultra-Sensitive H.T. Electrostatic Indicating Voltmeter. W. R. Harper. *Journ. Sci. Instruments,* 10. *pp.* 13–17, *Jan.,* 1933.—An instrument is described which indicates a change of 1 part in 1000 in a voltage of 45 kV by the shift of a spot of light through several millimetres, and which takes up its reading in under 2 sec. Its repeatability is guaranteed by the use of a quartz torsional control; and by supporting the moving part at both ends the disturbing effect of vibrations is eliminated. It is completely self-shielded from electrostatic disturbance, is small and not difficult to construct. It is therefore an indicating instrument specialised for use when a h.t. voltage has to be maintained accurately constant, as, for example, when carrying out X-ray ionisation measurements. It is not suitable for absolute determinations of voltage. AUTHOR.

See also Abstracts 1939, 2076.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

2054. Resistance Variation of Bismuth Crystals in a Magnetic Field. Part I. Electrical Method of Crystal Structure Analysis. O. Stierstadt. *Zeits. f. Physik,* 80. 9–10. *pp.* 636–665, *Feb.* 16, 1933.—Measurements are described of the change in electrical resistance of a single bismuth crystal due to an applied magnetic field, for various orientations of the magnetic field direction, crystal axis, and direction of electric current. The crystal was mounted in a special goniometer which enabled the angle between the magnetic field and the current direction (fixed with respect to the crystal) to be varied continuously. By using crystal specimens cut along different planes the orientation of the current direction with respect to the crystal axes could be modified. The curves of resistance variation against magnetic field orientation, show characteristics associated with the structure planes of the crystal and a method of crystal structure analysis based on the effect of magnetic fields on electrical resistance, is proposed. W. S. S.

2055. Theory of Galvanomagnetic and Galvanoelastic Effects. N. Akulov. *Zeits. f. Physik,* 80. 9–10. *pp.* 693–698, *Feb.* 16, 1933.—The relation between the change of resistance of a single iron crystal magnetised to saturation, and two constants characterising the anisotropy of the crystal, is worked out. Webster's measurements are used to test the relation and to determine the values of the constants. Using these values and the theoretical expressions for the effect of magnetisation intensity on the resistance of unsaturated iron crystals, curves in good agreement with experiment are derived. The theory of the galvanoelastic effect is shown to yield to treatment similar to that given for the galvanomagnetic effect. W. S. S.

MAGNETISM AND ELECTROMAGNETISM.

2056. Transition from the Integral to the Differential Laws in Electromagnetism and Induction. R. Chevallier. *J. de Physique et le Radium,* 4. *pp.* 54–60, *Jan.,* 1933.—The author states and proves the so-called " variation of the flux " theorem enunciated by Hertz in 1890, and shows how the theorem enables one to pass immediately from the classical integral laws of electromagnetism and induction, to the differential laws (Laplace's formula and the formula giving the e.m.f. induced in an element of a circuit). W. S. S.

2057. Susceptibility of Liquid Mixtures with a New Apparatus. L. Sibaiya and H. S. Venkataramiah. *Indian Journ. Phys.* 7. *pp.* 394–404, *Dec.* 1, 1932.—The diamagnetism of liquid mixtures has been investigated by weighing a pendant drop in a nonhomogeneous magnetic field. The variation in the time of formation of the drops is shown to affect the value of the susceptibility in the direction of enhancing the true deviation from the mixture law. The results obtained for pure liquids are, however, in good agreement with the accepted values. The deviation of the susceptibility of the acetone-chloroform mixture from the mixture law has been studied with a new apparatus. A cylindrical glass test piece with the opposite quadrants ground off for obtaining high sensitiveness is suspended under the liquid at the lower end of a torsion fibre in a nonhomegeneous magnetic field. As the twist due to the couple on the test piece is linearly related to the volume susceptibility of the surrounding liquid, the specific susceptibility has been determined with an error not exceeding 1 %. The observed maximum deviation of about 3 % agrees well with the results of most observers. This deviation, which some investigators deny, is shown to be theoretically expected. AUTHORS.

2058. Magnetic Susceptibility of Several Systems of Binary Alloys. Y. Shimizu. *Tohoku Univ., Sci. Reports,* 21. *pp.* 826–850, *Dec.,* 1932. *In English. Report No.* 296 *of the Research Inst. for Iron, Steel and other Metals.*—The relation between susceptibility and concentrations has been measured for the binary systems Au–Ag, Au–Cu, Sb–Bi, Pt–Pd, Sn–Bi, Bi–Pb, Cd–Sn, Sb–Pb, Bi–Te, and Al–Sn. All alloys were prepared by melting and annealing in vacuo as traces of absorbed gases have a marked effect on the susceptibility. For alloys forming continuous solid solutions, the maximum deviation of susceptibility from the values calculated from the additive law is only a fraction of 1 %. Earlier investigators, *e.g.*, Spencer and John [see Abstract 193 (1928)] state that on the addition of a small quantity of tin lead, etc., to bismuth or antimony the diamagnetic susceptibility of the latter decreases rapidly. This effect which is usually attributed to compound formation, is spurious and is due to traces of absorbed gases. Further, the abnormal susceptibility-concentration curves obtained by Spencer and John for the Cd–Sn and Al–Sn systems are to be attributed to the presence of absorbed gas. F. J. W.

2059. Diamagnetic Susceptibility of Inorganic Compounds. Part III. Oxyacidic Salts and Chlorides. K. Kido. *Tohoku Univ., Sci. Reports,* 21. *pp.* 869–881, *Dec.,* 1932. *In English.*—The susceptibilities of the oxyacids and chlorides of the elements in groups IV, V, VI and VII of the periodic table were investigated with the object of finding the relation between the susceptibility of the molecule and that of its constituent atoms. Values were found for fifty compounds, and, assuming an additive law, the susceptibilities of the oxyacidic ions were obtained by subtracting the ionic susceptibility of the kation from the molecular susceptibility of the salt. In the case of ions with similar co-molecular structure the ionic susceptibility decreases as the nucleus charge of the central atom in the same group increases (from phosphorus to chlorine), and it increases as the nucleus charge of the central atom in the same series increases (from chlorine to iodine). G. E. A.

2060. Diamagnetic Susceptibility and Refraction According to Wave Mechanics. B. Mrowka. *Zeits. f. Physik,* 80. 7–8. *pp.* 495–505, *Feb.* 6, 1933.—The methods of van Vleck [see Abstract 1986 (1928)] and

Bitter [see Abstract 776 (1930)] are extended and the susceptibility of hydrogen is calculated by a method of wave mechanics using universal constants; the resultant value is in good agreement with ascertained data. Certain methods of calculating ionic refractions and susceptibilities are discussed, and a new procedure is outlined by means of which values for Li^+, Na^+, K^+, Rb^+, Mg^{++}, Ca^{++}, Sr^{++}, Ba^{++}, Cl^- Br^-, and I^- have been determined. W. R. A.

2061. Diamagnetic Susceptibilities of Mixtures of Substances having large Electric Moments. J. E. Garssen. *Comptes Rendus*, 196. *pp.* 541–543, *Feb.* 20, 1933.—Examination of solutions of nitrobenzene and *p*-nitraniline in acetone has revealed the fact that the diamagnetic susceptibilities of these mixtures is not a linear function of the concentration, and it is suggested that the deviation from the additivity law may be due either to chemical combination between solute and solvent or to association in the solute molecules. W. R. A.

2062. Susceptibility and Electrical Conductivity of Copper-Manganese Alloys. S. Valentiner and G. Becker. *Zeits. f. Physik*, 80. 11–12. *pp.* 735–754, *Feb.* 23, 1933.—Alloys of varying content of electrolytic copper and purified manganese were cast in the form of rods and subjected to an ageing treatment before being magnetically tested by a ballistic method at temperatures down to that of liquid air. The mass susceptibility has a maximum value for 25 % atomic content of Mn, *i.e.*, 1 Mn atom alloyed with 3 Cu atoms. The maximum becomes more prominent as the temperature falls. Down to –60° C. the susceptibility follows the Curie-Weiss law, thereafter the susceptibility is greater than that given by it. The specific resistance at room temperature increases with Mn content, from $0 \cdot 31 \times 10^{-4}$ ohm cm. for 10 % atomic content to $1 \cdot 73 \times 10^{-4}$ at 90 %. The value calculated for pure Mn at 20° C. is $0 \cdot 28 \times 10^{-4}$ ohm cm. with a temperature coefficient of 0·0039. G. E. A.

2063. Diamagnetism of Conducting Electrons. R. Peierls. *Zeits. f. Physik*, 80. 11–12. *pp.* 763–791, *Feb.* 23, 1933.—The methods of quantum statistical theory are applied to investigate mathematically the diamagnetic susceptibility of free electrons, the effects of collisions and the magnetic characteristics of bound electrons. The theory indicates that the diamagnetism of an electron gas is only appreciably affected by impacts when the impact energy, h/τ, characterising the frequency of impact, $1/\tau$ is greater than kT, the symbols having their usual significance. But even then the susceptibility in weak fields is unaffected. Likewise the susceptibility is unchanged whether the electronic mean free path is greater or smaller than the orbital radius. J. S. G. T.

2064. Vibration Galvanometer Independent of Frequency. W. Meissner and U. Adelsberger. *Zeits. f. techn. Physik*, 14. 3. *pp.* 111–118, 1933. *From the Reichsanstalt.*—Discusses the mathematical theory of the galvanometer described previously [see Abstract 785 (1933)] for which there is a range where the sensitivity is independent of frequency. J. H. A.

See also Abstracts 1700, 1749, 1849, 2055.

MEDICAL RADIOLOGY AND ELECTROLOGY.

2065. Action-Current as a Measure of Muscle Contraction. R. H. Stetson and H. D. Bouman. *Science*, 77. *pp.* 219–221, *Feb.* 24, 1933.—It has been considered impossible to show a definite quantitative variation of the action current with the contraction of human muscle. Upon contraction the oscillations of the oscillographic curve, which are always present, even with resting muscle, coarsen and widen, but it is impossible to correlate changes of frequency or changes of amplitude with the degree of contraction, for the reason that the oscillations, during the contraction, have no definite frequency and no definite amplitude. Planimetric measurement of the area of the oscillographic curve during the contraction disturbance is possible, but tedious and inaccurate. Measurement by ballistic galvanometer is convenient and accurate. The measurement is the less difficult part of the problem as, to measure the force of contraction of the muscle, a group of muscle fibres must be isolated, since, if the contraction is opposed by antagonistic muscles, excess heat is developed, which cannot be measured. The authors discuss piano playing by skilled players as a type of ballistic movement, in which normal muscular antagonism is practically absent. Since the mass of the moving limb is constant and the path of excursion can be constant, the velocity of the ballistic movements becomes a measure of the varying force of the contractions. Measurements have been made of such movements utilising electrodes of Ag or Zn, wrapped in muslin wetted by salt solution and recorded on a kymograph. The ratios of excursion to velocity of the movement were measured and an equation can be derived, which indicates that a constant number of muscle fibres is employed in overcoming the fixed resistance. Parallel records were made by a ballistic galvanometer of the summated action currents of the flexor muscles and, by means of a second galvanometer, of the summated action currents of the extensors. The sum of the summated flexor and extensor action currents should be proportional to the length of excursion of the respective series of movements. It is possible to make ocular demonstration of this quantitative relation by suitable amplifying apparatus. The results are found to agree with the " all-or-none " hypothesis for the contraction of the muscle fibres. When fatigue occurs and the muscular movements are no longer co-ordinated, the records become irregular. B. J. L.

2066. Physical Conditions Relating to the Laws of Electrical Excitation of Nerve and Muscle. A. Strohl. *J. de Radiologie et d'Electrologie,* 17. *pp.* 65–71, *Feb.,* 1933.—Neuro-muscular excitation can be obtained by the application of various excitors, such as mechanical shock, etc. With reference to electrical excitation Hoorweg has propounded a law $V = a + bC$, where V is the potential, C the capacity of the condenser utilised and a and b constants, determined by the particular conditions. V determines the displacement of ions within the tissues and C the rapidity of propagation of the electrical wave. By utilisation of the results of work carried out by Lapicque the present author demonstrates that it is possible, by the use of suitable co-ordinate scales, to reduce curves of excitation, obtained under varying conditions, to correspond with a standard curve. For example the law of Weiss $q = a + bt$, where q is quantity of electricity and t the time of application, can be shown to agree with the Hoorweg law. The heterogenous structure of tissues, with relating variations of permeability of the ions, results in the accumulation of ions at certain membranes and a resulting polarisation, which opposes the further passage of current. Such polarisation is a cause of error in electrophysiological measurements. To reduce polarisation, high ohmic resistance is introduced in series with the subject. Owing to the varying factors one must recognise that the law of excitation may depend upon the particular conditions of experiment. The author discusses a suitable electrical circuit to excite nerve and muscle tissues for physiological research, which allows a variable or invariable law of excitation, controlled by the circuit resistance. The circuit is discussed in detail, and the types of linear curves obtained are shown and considered. B. J. L.

2067. Method of Outlining Cutaneous Nerve Areas. I. M. Thompson and V. T. Inman. *Science*, 77. *pp.* 216–217, *Feb.* 24, 1933.—In 1928 the authors discovered that the area of skin supplied by a nerve can be rendered insensible to light touch by subjecting the nerve trunk to the influence of an alternating current. This observation may be utilised in order to map out areas of nerve supply or, alternatively, to confirm the recognised method of investigating these areas in pathological cases of nerve lesions. An apparatus to supply the alternating current is described, a d.c. supply being converted to a.c. by means of an Alexanderson alternator, the frequency of the alternating current being controlled by a variable resistance and estimated from the number of teeth and speed of rotation, and the current strength was controlled by other variable resistances. The results of this method of investigation, applied to the forearm, in respect to the areas of supply of different nerves, is illustrated. The method is of particular value as it illustrates how the supply of different nerves may overlap and that the area supplied may vary in different individuals. B. J. L.

2068. New and Rapid Intensifying Screen. L. Levy and D. W. West. *Brit. J. of Radiology*, 6. *pp.* 85–102, *Feb.*, 1933.—A description of the properties of a new type of zinc sulphide fluorescent screen which is much faster than screens of normal material. W. V. M.

2069. New Intensifying Screen. N. S. Finzi. *Brit. J. of Radiology*, 6. *pp.* 103–107, *Feb.*, 1933.—A description of some medical uses of the new intensifying screens. Examples of radiographs are given. W. V. M.

2070. Photochemical Considerations in the Action of Ultra-Violet Light on the Human Skin. W. Frankenburger. *Naturwiss*, 21. *pp.* 116–124, *Feb.* 10, 1933.—The author considers the variation of absorption of ultra-violet light in human skin with wave-length, in conjunction with the known variations in erythema producing power. From this and other evidence it is concluded that it is probable that tyrosene is the parent substance of the ultra-violet pigment and histadine that of the erythema producing material. W. V. M.

2071. Investigation of Ultra-Violet Radiation. L. Zehnder. *Zeits. f. Physik*, 80. 9–10. *pp.* 699–700, *Feb.* 16, 1933.—Means are discussed of making spectrum analysis possible for very weak radiations such as mitogenetic rays. W. V. M.

2072. Erythemal Measurement of Ultra-Violet Radiation. A. H. Taylor. *J.O.S.A.* 23. *pp.* 60–66, *Feb.*, 1933.—Erythema (reddening of the skin) is very generally used as a guide to dosage in ultra-violet therapy, since there is no reliable information as to the relative effectiveness of different regions of the ultra-violet spectrum in promoting health or in curing disease. The curve connecting the erythemic reaction of the human skin with the wave-length of the radiation is now fairly well established and is given in the paper. Two lamps can be compared by determining the minimum exposure which produces a just perceptible erythema in each case. The exposure required to produce a minimum perceptible erythema (M.P.E.) varies with different individuals and, for the same individual, with the part of the body exposed, so that two sources must be compared by exposing neighbouring portions of skin of the same individual. The author has investigated the use of physical apparatus to replace the human skin. A number of different types of photoelectric cells, and some specimens of blue-fluorescing glass were used. The spectral sensitivity curves of each are reproduced in the paper. It is concluded that a cadmium photoelectric cell with Corex D bulb gives results which approximate most closely to the erythemal tests. In view of the low precision obtainable with erythemal measurements the cell is considered to be satisfactory. Its sensitivity is low, however, and sensitive measuring apparatus is required. J. W. T. W.

2073. Experimental Clinical Research Work with X-Ray Voltages above 500 kV. A. Soiland. *Radiology*, 20. *pp*. 99–102, *Feb.*, 1933.—The author has had the opportunity of utilising, for curative purposes, an X-ray installation operated at 1000 kV with an X-ray tube voltage of 750 kV and a current of 5 mA, constructed by Millikan and Lauritsen. Experimental treatment was commenced in October, 1930, upon inoperable cases of cancer. Although the author considers sufficient time has not yet elapsed fully to judge the therapeutic results of such h.t. radiation, it is remarked that cases which had previously been treated at, say, 220 kV, and become immune to radiation, showed further response to this higher voltage radiation, although the author is not prepared to distinguish whether this further effect is due to selective wave-length action, or to better application of the depth dose irrespective of wave-length. The future use of such h.t. X-ray apparatus in therapy is discussed as regards initial cost of installation of apparatus, need of skilled engineering maintenance and dangers of operation, both electrical and due to X-rays, particularly in respect to hitherto unknown factors of danger.
B. J. L.

2074. Advantages and Disadvantages of Small-Chamber Measuring Instruments. H. B. Hunt. *Radiology*, 20. *pp*. 128–135, *Feb.*, 1933.—Small ionisation chamber ionoquantemeters offer advantages in clinical and physical applications of X-rays, but suffer from errors due to various factors, such as wall effect, etc. They should therefore be calibrated and checked from time to time against a standard source of radiation, or a standard ionisation chamber. Corrections must be applied for variations of temperature, barometric pressure, wave-length, leakage, etc. In a modern small-chamber instrument these variations can be controlled to such an extent that, within the normal range of X-ray dosimetry, the error is less than 3 %, although the errors are increased with very short, or very long wave-length radiation. For very short wave-lengths, with the instrument investigated, an effective wave-length shorter than 0·14 Å renders the estimation of the errors difficult. In spite of the inaccuracies, the small-chamber instrument offers advantages of localised application and is suitable for teaching purposes. It is shown that back-scattering of radiation may increase a total skin dose from 5 % to 65 %, according to the size and contour of the field of irradiation, region of the body, etc. In view of the many variables, it is fallacious to calibrate the X-ray output with one size of cone and one back-scattering medium, and then to apply dosage values, so derived, to other regions, in which the size of field of irradiation, etc., may vary. Hence direct measurement should be made under the actual particular conditions of irradiation. The variations due to scattering, which may amount from 10 to 50 %, overshadow the inherent error of 2 or 3 % of the actual instrument. Various curves are given to illustrate the various points discussed in the paper. B. J. L.

2075. Diffusion of Visible and Ultra-Violet Light by Human Skin. T. Kofman. *Comptes Rendus*, 196. *pp.* 434–436, *Feb.* 6, 1933.—The paper describes briefly measurements which show that in the case of both visible and ultra-violet light the diffusive power of the skin varies only slightly with the pigmentation. A thin layer of oil on the skin does not affect the diffusion of visible light, but considerably increases the diffusive power of the skin for ultra-violet light. W. E. P.

See also Abstract 1843.

OSCILLATIONS.

2076. 3000-kV Impulse Generator. T. E. Allibone, F. S. Edwards and D. B. McKenzie. *Nature*, 131 *pp.* 129–130, *Jan.* 28, 1933.—It has been found that the time of breakdown of a spark-gap decreases with increased air pressure, while at the same time the breakdown voltage increases. Taking advantage of this the authors have constructed a very compact 3000-kV impulse generator of which the condensers are immersed in oil and the spark-gaps, which by sparking over put the condensers in series, are in an air space at several atmospheres pressure. A very steep-fronted pulse is obtainable in this way, it being possible to obtain a rate of rise of potential of 6000 kV per microsecond when operating at $2 \cdot 5 \times 10^6$ V. Some oscillograph records are reproduced which exhibit the effect of pressure upon the steepness of the wave-front due to the pulse. J. E. R. C.

2077. Propagation of Electric Oscillations along a Tube Containing an Ionised Gas. C. Gutton and (Miss) M. Chenot. *Comptes Rendus*, 196. *pp.* 589–591, *Feb.* 27, 1933.—When a tube containing a gas under a pressure of 0·001 mm. of Hg is approached by a valve-oscillator, emitting waves of a few metres, in wave-length, under certain conditions the tube glows. Bright and non-luminous parts are seen, due to stationary waves. A brief theory is given of the movements of the ionised centres in the tube when subjected to a h.f. electromagnetic field. Assuming that only electrons can oscillate, the velocity of propagation is given by $V = k e d \sqrt{\frac{N}{m}}$; where e is the charge, m the mass, N the number of electrons, d the diameter of the tube and k a constant. [See Abstract 2781 (1931).] H. M. B.

See also Abstract 2064.

PHOTOELECTRICITY.

2078. Photoelectric Emission from Metastable Atoms. C. Kenty. *Phys. Rev.* 43. *pp.* 181–193, *Feb.* 1, 1933.—The causes of conductivity observed at considerable distances beyond the end of a rare gas discharge are investigated at pressures of 0·5–2 mm. In pure gases, currents from negatively charged electrodes are found to be mainly caused by photoelectric action thereon of the resonance or other extreme ultraviolet radiations. For similar discharge conditions, currents are roughly 10-fold greater in Ne than in He and 20-fold greater in Ne than in A. When traces of impurities (ionisable by metastable atoms) are added, the currents are increased because of the ionisation of the former metastable atoms (volume effect). Under these circumstances strong irradiation with light of the gas in question (which is found to destroy more than half the metastable atoms formed) causes marked decreases in the currents; but the currents in the pure gases are only negligibly so reduced. Electron currents from a metal disc are several times greater when the plane of the disc is perpendicular to the direction of the radiation than when it is parallel thereto. The fraction of the currents in Ne which may be caused by the emission of electrons from surfaces by metastable atoms is $< 10\%$ for the parallel position of the above disc and $< 3\%$ for the perpendicular position. This fraction is still smaller in A, but may be considerably higher in He. The fraction of the scattered resonance quanta which are converted into metastable atoms before reaching the walls may be as high as 50 % in He but is probably $< 5\%$ in Ne. The small value of this fraction in Ne is in accord with other evidence for the abnormally long free paths of resonance radiation in this gas. E. E. F. d'A.

2079. Selective Photoelectric Emission from Compound Alkali Kathodes. W. Kluge. *Phys. Zeits.* 34. *pp.* 115–126, *Feb.* 1, 1933.—Enumerates the various methods of producing a selective photoelectric effect in the alkali metals. All the types have two maxima of sensitiveness. The short-wave maximum is the same for each alkali metal, and lies at about 410$m\mu$. The long-wave maxima are the longer the greater the atomic weight. No long-wave maximum could be found for Na, probably because it is covered by a short-wave maximum. Caesium has not yet been hydrated, but it will probably show a selective maximum at 540 $m\mu$.
E. E. F. d'A.

2080. Sensitiveness of Caesium Oxide Kathodes. G. Déjardin and R. Latarjet. *Comptes Rendus,* 196. *pp.* 470–473, *Feb.* 13, 1933.—Describes the preparation of photoelectric caesium kathodes. The sensitive surface consists of a base of caesium oxide, silver oxide, and finely divided caesium with a very thin layer of adsorbed caesium. The base of the tube consists of lead glass and is heated to 350°, while the cylindrical portion containing the kathodes is of a glass not attacked by caesium vapour and is kept at 200°. During the slow maturing of the cell in an atmosphere of argon, the maximum sensitiveness changes from 8050 Å to 6700 Å and the limiting sensitiveness from 12,300 Å to 9600 Å.
E. E. F. d'A.

2081. Electrical Phenomena in Lead Glance Crystals Caused by Light, Heat and Kathode Rays. E. Rupp. *Zeits. f. Physik,* 80. 7–8. *pp.* 483–494, *Feb.* 6, 1933.—In single lead glance crystals there arises by irradiation, or one-sided heating, an e.m.f. which is due to the displacement of electrons in the direction of the energy gradient of the absorbed radiation or heat. In the case of irradiation the phenomena in liquid air are analogous to the crystal photoelectric effect found by Dember [see Abstract 4297 (1931)]. The electronic displacement by heat has now been determined for the first time on both sides of an isolated crystal and is characterised as a crystal thermal effect. The spectral distribution of the photoelectric effect has a pronounced maximum at 400 $m\mu$. The crystal photoelectric effect is superposed by a thermal effect in the red and ultra-violet part of the spectrum. In lead glance, an e.m.f. arises by electronic impact, and its dependence upon the strength and voltage of the electronic stream is investigated. The crystal thermal effect has also been established for cuprite [see also Abstract 4572 (1932)]. H. H. Ho.

2082. Electron Emission of Metals under the Influence of Monochromatic X-Rays. H. Hase. *Zeits. f. Physik,* 80. 9–10. *pp.* 670–689, *Feb.* 16, 1933.—The electron emission of Fe, Cu, Mo, Ag, Sn, Ta, W, Au, Pb and Bi at the entrance side and Cu, Sn, and Au at the emergence side was investigated with monochromatic X-rays, and in the case of Cu, Sn, W, Au and Bi compared with Küstner's theory. It is shown by exact calculation that the chief source of emission in the case of the heavy elements is only in a small degree to be traced to electrons of the second kind, but in reality is to be found in electrons of the third kind. The maximum of electron emission occurs for all elements at about 0·19 Å. Küstner's theory interprets the experimentally determined electron emission in general qualitatively and quantitatively as well as is to be expected, considering the numerous still experimentally doubtful factors which enter into the calculation. J. J. S.

2083. Current Reversal from a Cuprous Oxide Photoelectric Cell in Red Light. H. H. Poole and W. R. G. Atkins. *Nature,* 131. *p.* 133, *Jan.* 28, 1933.—A small reverse current is observed in some rectifier photoelectric cells, such as the Serpidox and the Auger cells. The inverse effect is irregularly distributed over the cell, as was shown by successively illuminating various areas, each about 4 mm. in diameter, with a beam of light of wave-length between 6070 Å and 6270 Å. For a region, some 5–6 mm. square, not quite central in the pupil, the current obtained was in the same direction as that for green, blue, or white light. For all other parts of the disc a varying negative response was obtained. As the current flowing in the external circuit under the influence of white light is from the copper back to the transparent film, it would seem probable that it is due to a front-surface effect of the cuprous oxide film, the back surface being screened by the opacity of the film. If it is assumed that red light penetrates the thinner parts of the oxide film in the Serpidox and Auger cells to such an extent as to cause the back surface effect to preponderate, explanation is obtained of the patchy nature of the red reversal. E. E. F. d'A.

2084. Effect of X-Rays on Rectifier Photoelectric Cells. K. Scharf and O. Weinbaum. *Zeits. f. Physik,* 80. 7–8. *pp.* 465–482, *Feb.* 6, 1933.—A Siemens Cu_2O cell showed no fatigue even after prolonged action of X-rays. But selenium rectifier cells showed considerable fatigue, though the initial current was proportional to the illumination, and reached about four times the value it did in the copper oxide cells. [See also *Phys. Zeits.* 34. *p.* 283, *April* 1, 1933.] E. E. F. d'A.

2085. Photronic Photoelectric Cells. B. P. Romain. *Rev. Sci. Instruments,* 4. *pp.* 83–85, *Feb.,* 1933.—The internal leakage path in the photronic cell may be regarded as consisting of three conductances which are: (1) a conductance which is a constant for a given cell; (2) a conductance which is directly proportional to the illumination of the cell; (3) a conductance which is directly proportional to the total internal leakage current in the cell. Experimental data are presented which apparently justify this conception, and formulæ are developed from which the current in the external circuit and the open circuit e.m.f. may be calculated under varying conditions of use. E. E. F. d'A.

2086. Saturation Current in Photoelectric Conduction of Röntgenised Rock-Salt. N. Kalabuchow. *Zeits. f. Physik*, 80. 7-8. *pp.* 534–541, *Feb.* 6, 1933.—The saturation-curve has a stepped character. The same results are obtained whether with blue, red or white light. A. D.

2087. Electronic and Chemical Effects in Photovoltaic Cells. R. Audubert. *Comptes Rendus*, 196. *pp.* 475–478, *Feb.* 13, 1933.—The potential at which the photovoltaic effect disappears in the case of Cu_2O is independent of the wave-length. This is contrary to Einstein's relation, which is strictly verified in the pure photoelectric effect. The curves for the various wave-lengths run together at zero potential for the photovoltaic effect, while those for the photoelectronic originate at different negative potentials. This disparity gives a means of distinguishing photovoltaic from pure photoelectric effects. E. E. F. d'A.

2088. New Photoelectric Phenomenon. Q. Majorana. *Accad. Lincei, Atti*, 16. *pp.* 548–552, *Dec.* 4, 1932.—A continuation of previous work [see Abstracts 799 and 1236 (1933)] confirming the reality of the phenomenon and separating it from purely thermal effects. The author does this by four different methods. That the resistivity of most metals is increased by the action of light is shown by substituting a manometric flame for the light. No note could be heard in the telephone when a flame vibrating at 500 ∼ was made to play on a silver sheet. The photoelectric effect is also separated from the thermal effect by covering the sheet with lampblack or allowing a stream of water to flow over it. The first process emphasises the thermic effect, the latter the photoelectric effect. The phase difference between light pulsation and pulsation of resistance is zero with a water current, and 45° with a coating of lampblack Also, on examining the action of various musical frequencies, it is found that a lamp-blacked sheet shows an effect decreasing with rising frequency, whereas it increases with a bare sheet. E. E. F. d'A.

See also Abstract 2072.

THERMIONICS.

2089. Determination of Work of Emission from Oxide Kathodes. W. Heinze. *Ann. d. Physik*, 16. 1. *pp.* 41–76, *Jan.*, 1933.—It is shown that the work of emission from hot kathodes may correctly be determined from the cooling due to the emission by means of Richardson's equation, and the sources of error in earlier measurements by the cooling method are pointed out. Improvements in the apparatus and method are described; these rendered the errors small, in particular that due to the internal resistance of the tube. An empirical relation was found between the emission current in the neighbourhood of saturation and the anode potential; this relation takes the place of one derived from Schottky's theory in the case of oxide kathodes and serves for the conversion of the emission work found experimentally to zero external field. The values found for the work of emission from the oxide kathodes employed were from 1·87 to 2·05 volts. These results point to the existence of a dependence of the work of emission on temperature, the work of emission probably increasing with rise of temperature. A. W.

2090. Space Distribution of the Emission from the Glowing Kathode. F. Hamacher. *Arch. f. Elektrot.* 27. *pp.* 47–56, *Jan.* 7, 1933.—Linear and non-linear kathodes are heated to different temperatures and the emitted electrons after traversing different spaces are allowed to fall on a fluorescent screen, which also acts as anode. Photographs, from which the visible light of the kathode is eliminated, are taken and graphs obtained between the space distribution and various factors, such as temperature, length of wire, etc. The experiments are extended to find how much the Wehnelt cylinder concentrates the beam of electrons and what is the influence of potential-carrying screens on the space distribution. H. M. B.

2091. Effect on Electron Paths of the Heating Current Field of Glowing Kathodes. F. Hamacher. *Arch. f. Elektrot.* 27. *pp.* 121–124, *Feb.* 14, 1933.—An experiment is performed to determine how the electron paths are affected by the field of the heating current of a glowing kathode. A theoretical determination of the deviation of the path is made and is found to be in fair agreement between theory and practice, any discrepancies being accounted for by the necessity of neglecting certain quantities such as space charge and so forth. H. M. B.

2092. Diffusion of Thorium in Tungsten. G. R. Fonda, A. H. Young and Amy Walker. *Physics*, 4. *pp.* 1–6, *Jan.*, 1933.—Thoriated tungsten wires are so heat-treated in gas as to develop variations in grain size, ranging in length from 4 μ to 3 cm. These variations produced marked changes in the thermionic emissive characteristics, such as rates of deactivation and of activation and duration of emissive life at normal operating temperature. The heat of diffusion remained unaffected. It was concluded that intergranular diffusion of thorium through tungsten is relatively too rapid to be measured and that the observed phenomenon depends purely on intragranular diffusion. This conception is in accord with the existence of a critical grain size for the realisation of a maximum emissive life. Experiments are also described to demonstrate the spreading of thorium atoms over the surface of a single crystal of tungsten and to manifest the effect of slight strains in the lattice upon activation. AUTHORS.

2093. Positive Ion Work Function of Tungsten for Alkali Metals. R. C. Evans. *Roy. Soc., Proc.* 139. *pp.* 604–617, *March* 3, 1933.—In an earlier paper [see Abstract 5211 (1932)] Moon and Oliphant made a qualitative study of the evaporation of positive ions of potassium from a hot tungsten surface. In the present paper a quantitative study of the phenomenon is made and extended to rubidium and caesium. Only the re-evaporation of slow positive ions is considered. A beam of ions is directed upon a tungsten target maintained at a known high temperature and the current due to positive ions re-emitted from this surface after the incident beam is cut off is investigated. It is found to decay in an exponential manner down to a final positive value. The theoretical significance of these results is discussed, and it is shown that the values of the positive ion work function deduced from them is in accord with the expected values. J. E. R. C.

2094. D.C. Amplifier. P. A. Macdonald and Jean T. Macpherson. *Phil. Mag.* 15. *pp.* 72–81, *Jan.*, 1933.—The instrument gives an overall amplification as large as 10^8, the principle employed being based on the fact that the direction of flow of the grid current in a thermionic valve is reversed at a definite grid potential. J. H. A.

THERMOELECTRICITY.

2095. Theory of Thermoelectric Effects at Low Temperatures. W. Kroll. *Zeits. f. Physik*, 80. 1–2. *pp.* 50–56, *Jan.* 6, 1933.—The thermoelectric force at low temperatures is calculated not according to the complicated, though strict, equations of Peierls, but following the simpler statements of Bloch and Nordheim. J. J. S.

2096. Inverse Joule Effect. C. Benedicks and G. Siljeholm. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 23B. 3. *pp.* 1–3, 1933. *In English.*—Benedicks has pointed out that besides the thermoelectric effects of the first and second degree analysed by him a thermoelectric effect which is the inverse of the Joule effect ought to exist, being the thermal generation of an alternating current or of a pulsatory direct current of the same frequency as that of the atoms. This idea is discussed quantitatively and it is suggested that it is supported by the experimental results obtained by J. B. Johnson who found that statistical fluctuation of electric charge exists in all conductors producing random variation of potential between the ends of the conductor [see Abstract 2811 (1928)]. J. J. S.

2097. Change of the Thermo-E.M.F. on the Recuperation of Metals from Mechanical Treatment when Cold. G. Tammann and G. Bandel. *Ann. d. Physik*, 16. 1. *pp.* 120–128, *Jan.*, 1933.—Between a hard and a soft wire of the same metal there exists a thermo-e.m.f. of the magnitude of about 1×10^{-6} volt per degree. The electrons flow at the hot junction from hard to soft metal, but in iron in the reverse direction. In the curve representing the change of the thermo-e.m.f. with temperature there is first a linear rise and then a strongly curved portion continued in a straight line indicating no change with temperature. The curved portion of the curve indicates the behaviour during the passage of the hard wire into the soft condition. Various metals were examined, and their thermoelectric behaviour in this restoration portion of their course on heating was investigated, and the results are given in tables and curves. The effects of previous mechanical treatment such as traction and torsion are indicated. The metals dealt with are Ag, Cu, Au, Mg, Fe, Ni, Pt, and Pd. J. J. S.

See also Abstract 2081.